The

Geographical Journal.

No. 4. OCTOBER, 1901. Vol. XVIII.

THE ANTARCTIC VOYAGE OF THE "BELGICA" DURING THE YEARS 1897, 1898, AND 1899.*

By HENRYK ARCTOWSKI, of the Scientific Staff of the Expedition.

Since the date of the memorable voyages of Ross, Wilkes, and D'Urville, the record of antarctic discovery tells us of very few enterprises of the kind for many years subsequently, not a single important step having been taken, after these voyages, towards the improvement of our knowledge of the antarctic, until the moment when the *Challenger* pushed forward, as far as the polar circle, among the ice of the Southern ocean. After this came the years in which Prof. Neumayer and Sir John Murray devoted themselves to the task of arousing the interest of the scientific world in antarctic questions, and stirring it up to new efforts. In this they at last succeeded, for it is doubtless in great measure due to their advocacy that a new era of research has now begun.

On the eve of the departure of the National Antarctic Expedition, organized under the joint auspices of the Royal Society and the Royal Geographical Society, as well as of those to be sent out from Germany, Sweden, and Scotland, I wish to describe to you the doings of the Belgian Antarctic Expedition, a member of which I had the honour to be, and which was the first to winter amidst the ice of the south pole—the first of the several expeditions whose combined harvest of scientific results is destined to effect a complete revolution in our knowledge of the antarctic regions.

Now that the continent of Africa has been traversed in all directions, now that the centre of Asia is already well known in the broad outlines of its geography, while there is no longer a possibility that

* Read at the Royal Geographical Society, June 24, 1901. Map, p. 464.

anything essential can be added to our geographical knowledge by voyages to the north pole, the efforts of explorers must inevitably tend to disclose to us the mysteries of the "Terra Australis incognita." It is not merely the inaccessible or almost inaccessible coasts of the antarctic continent which have to be explored, but the whole broad expanse of ocean which bathes the lands of the south pole as well. And we can form no estimate what philosophic conclusions will be reached from the mass of new information to be gathered from the scientific exploration of so vast an extent of the surface of the globe. We must steadily advance, and history will teach us how much more important, for the whole future of the human race, are the pacific conquests of science than all the wars of destruction waged between nations in arms. I sincerely hope that the British Antarctic Expedition may meet with full success, and bring back a rich harvest of new scientific facts. And since this expedition is bound for a region not far removed from that in which we laboured, and as the *Discovery* may perhaps be blocked in the ice and winter in the pack as the *Belgica* did, I think that you will be particularly interested in hearing of the life that we lived amidst the ice during the long months in which the vessel remained imprisoned.

I will give but a very brief narrative of the voyage of the *Belgica*, for I wish also to dwell on the researches undertaken by the members of the Belgian Expedition and on the value of the observations brought back. The study of these materials involves the collaboration of a large number of *savants*, and it will therefore be impossible, until several years have elapsed, to form a clear idea of the results obtained, for up to the present two or three memoirs only have been completed.

The object of the Belgian Antarctic Expedition was *not* to pass the extreme points reached by Ross and Weddell. We aimed, on the contrary, at achieving something new—something which might better meet the requirements of modern geography, which year by year asks more of the co-operation of the natural and physical sciences. For this reason the *Belgica* was equipped for scientific work, to the end that at least some of the numberless questions awaiting solution in the antarctic, in the domain of all the sciences affiliated to geography, might be answered.

As regards the area yet unexplored, there is no doubt that the inscription "Antarctica terra incognita" will long remain inscribed in large letters in our atlases, but little by little the outlines of the southern lands will take more definite shape, and our knowledge of the southern continent—of which the existence is still enigmatical—will in time be satisfactory. The Belgian Antarctic Expedition will mark the first step, among contemporary enterprises, in lifting the veil of obscurity from the south polar ice-cap.

1. *Organization of the Expedition.*—The expedition in the *Belgica* was

a private undertaking subsidized by the Belgian Government. The initiative was due to Commander de Gerlache, who, from 1894 onwards, had entertained a wish to undertake a voyage of exploration to the south pole. This wish he expressed to various persons, including among others certain members of the Council of the Royal Belgian Geographical Society. It was one of these latter—M. Lancaster, I believe—who suggested to de Gerlache the plan of a scientific voyage, in the place of one of adventure—an idea which made its way in course of time. M. de Gerlache encountered difficulties from the very beginning. A scheme submitted to his Majesty King Leopold failed to gain his approval, and the original application for a grant of 800,000 francs (£32,000) yielded to a more modest programme involving an outlay of £12,000 only—with which comparatively small sum de Gerlache succeeded in covering the whole cost of the enterprise. Early in 1896 the Brussels Geographical Society, which gave its patronage to the project, organized a national subscription. The first 25,000 francs (£1000) were subscribed by M. Ernest Solvay, the well-known patron of research. Other important gifts, with subscription lists opened by local committees in the principal Belgian towns, the proceeds of lectures, fêtes, etc., helped the sum total to rise by degrees, while at the end of June, 1896, the sum of £4000 was unanimously voted by parliament. In spite of this, however, want of funds delayed the preparations, and the departure of the expedition was put off for a year. The vessel chosen was the smallest of the Norwegian whalers, formerly the *Patria*, which was purchased by de Gerlache for the sum of 70,000 francs (£2800). Although of recent construction, the *Patria* underwent some necessary repairs and alteration of fittings for the new services demanded of her. On July 5 the vessel was rechristened with the name *Belgica*.

The ship was a three-masted barque, 100 feet long, with a displacement of 250 tons, and auxiliary engines of 150 horse-power. The hull was protected by a casing of hard wood, to add strength and afford protection against the friction of the ice. Aft, on the deck, were placed the cabins of the officers and of the scientific staff, while in the fore part, under the bridge, a laboratory was rigged out. While these preparations were being made at Sandefiord, in Norway, the complete scientific equipment was ordered from the best makers in Europe, and our instruments were thus brought together from Paris, Vienna, Copenhagen, London, Berlin, Jena, etc. The purchase of stores, furs, and the whole equipment of the polar explorer likewise required much time and forethought. Even though we had more than a year at our disposal for these preparations, time fell short in the end, and in spite of all our efforts it was necessary to put off the date of departure. Funds, too, were lacking, for it soon became evident that the 233,000 francs (£9320) collected were not sufficient, and it was only on the Government again coming forward with a credit of

£2400 that we were able to leave Antwerp. In spite, however, of the rigorous economy which de Gerlache was forced to practise in order to keep the expenses within the scanty limit of the £12,000, a sufficient sum was devoted to the scientific instruments to save the expedition from any criticism on this score. It is true that the staff of the expedition received no remuneration, and that the wages of some of the crew were insignificant, while others were volunteers. It is equally true that the Belgian Expedition owed a debt of gratitude to many kind friends. Thus during the stay of the ship at Antwerp Mme Osterrieth took so lively an interest in the welfare of each of us that the crew of the *Belgica*, and, later, the whole of Antwerp, applied to her the title of "la mère antarctique." It was due to our President, Sir Clements Markham, and to the interest in the expedition taken by Sir John Murray, that we obtained from the Royal Society the 'Reports of the Voyage of the Challenger,' and from the Admiralty the whole series of nautical charts which were such a necessary part of the equipment of the expedition.

The *Belgica* left Antwerp on August 16, 1897. An accident to the machinery forced us to put into Ostend, and thus delayed our departure by a week, as we only left Ostend at 8 p.m. on the 23rd. One of my good friends, Antoni Dobrowolski, took advantage of this first mishap to embark with us. Two days before we left Antwerp he had come to bid me good-bye, and to inspect my arrangements. Like so many others, he saw over the *Belgica*, and even mounted into the crow's nest to obtain a general view of the Antwerp dock, and at last, when evening came, he disburdened himself of the question which had been on his mind the whole time, What should he do to be taken along with us? The thing was impossible; it was too late. Dobrowolski was a student at the University of Liége, and he would have had some difficulty in returning to collect his baggage and getting back to the ship in time; besides, the commander might perhaps not have accepted him; and, lastly, there was not another berth in the ship, all the beds being occupied.

But, directly we reached Ostend, I telegraphed to him, and he started off at once with two small packages, which he carried in his hand, and which were all he took with him for the long voyage which he meditated making. He came on board, and set to work with the rest of us on the final preparations for the voyage and the arrangement of the laboratory, which, at the moment of sailing, had not yet been completely set in order. The commander was surprised to see an extra hand on board, but, seeing that he was by no means *de trop*, decided to take him with us as laboratory assistant. Dobrowolski, as it turned out, rendered incalculable services to the expedition, for he carried out a good half of the hourly meteorological observations, and he made excellent notes on the clouds and on the phenomena of frost and snow.

It was also during these last days that our two best sailors—the Norwegians Knutsen and Johansen—were engaged in the place of two others who had left the ship. Now, too, the question of the medical officer was settled, for at the last moment we found ourselves without a doctor on board, the last of the three Belgian doctors who had been engaged having calmly remained at home after mature reflection. It was by means of the telegraph that Dr. Cook, of Brooklyn, arranged to go with us, and as there was no time for him to come to Europe, he joined us at Rio de Janeiro. These facts, and many others which I could cite, show how difficult it is to organize an expedition when one's resources are limited. It is true that there is no lack of volunteers. Each day of our stay at Antwerp people came asking to be taken with us, and de Gerlache received several hundred applications by letter, but these were for the most part from adventurers who had no idea of hard work, and who would have been incapable of rendering us the least service. Lunatics too were among the number of those who wished to embark on our ship, which every one came to see from curiosity. In three essential points the organization of the expedition was defective. Firstly, there was no written contract as between the staff and the leader of the expedition, and the functions of the several members were not sufficiently defined. Secondly, no written instructions were provided either by the Belgian Government, or by the Geographical Society, or by any other learned body. And, thirdly, no definite programme for the voyage had been drawn up.

The Belgian Antarctic Expedition maintained, therefore, the character of a private enterprise, in which the individual liberty accorded might easily have led to anarchy on board. If I lay stress on this point, it is because I feel that the example of the *Belgica* ought not to be followed. In a similar expedition, it is requisite not merely to make a good choice of the individuals who are to take part in it, but to do all in one's power, from the outset, to secure a proper organization, to define the duties of each one of the staff, so as to give stability to the enterprise, and, further, to provide a definite plan—just what we lacked.

2. *Ostend to Punta Arenas.*—The speed of the *Belgica* under steam being only from 4 to 5 knots, the crossing of the Atlantic was slow, and was of little interest. We neither sounded nor fished, so that the whole of the scientific work was comprised in the study of the surface water, from the point of view of temperature, colour, and density, and in the meteorological observations taken every two hours. In the Bay of Biscay we had very bad weather and a contrary wind, by which our progress was much hindered. The vessel was, besides, so overloaded that the deck was scarcely 2 feet above the water-line. Our situation was thus scarcely reassuring, and we congratulated ourselves when we had doubled Cape Finisterre. On September 11 we were at the port of

Funchal, Madeira, our first point of call, at which we spent three very pleasant days. Thence we sailed direct for Rio de Janeiro, where we remained a week, starting for Montevideo on October 30. At the entrance of the Rio de la Plata we were stopped by a "pampero," which blew with such violence that the captain felt it necessary to cast anchor in a little sheltered bay near Cape Polonio. On November 11 we were in Montevideo roads, and three days later we once more set our course for the south. On the 26th a storm compelled us to close reef, which caused a fresh loss of time. Finally, on November 29 we entered the Strait of Magellan, where, after halts at Cape Gregory and Elizabeth island, we cast anchor at Punta Arenas on December 1. Punta Arenas was the starting-point of our antarctic voyage. Here the commander took on board the coal necessary for the remainder of the voyage, and, profiting by a liberal offer on the part of the Argentine Government, modified his proposed route so as to complete his supply at the depôt of Llopotaia, in Beagle channel. It was this circumstance which gave us the opportunity of visiting the channels of Tierra del Fuego. Our departure was delayed by several desertions among our Belgian seamen, and we left Punta Arenas with a quite insufficient crew. The whole complement of the *Belgica* was thus reduced to nineteen men, viz. the following:—

Adrien de Gerlache, commanding; Georges Lecointe, second in command, and Roald Amundsen, officer; Emile Danco, Emile Racovitza, Henryk Arçtowski, and Antoni Dobrowolski, scientists; Frederick A. Cook, doctor; Henri Somers and Max van Rysselberg, engineers; Tollewsen, Melaerts, Johansen, Knutsen, Koren, Wiencke, Michotte, Dufour, Van Mirlo, seamen.

3. *Among the Channels of Tierra del Fuego.*—We took advantage of our stay at Punta Arenas to make some excursions in the neighbourhood. We went into the valley of the Rio las Minas, where a fine series of sections in the Tertiary sandstone and sand is to be seen. Here and there they contain fossils as well as deposits of lignite, one of which is worked. There are some gold-washers at work on the river, but the outturn is extremely small. Afterwards Dr. Cook and I visited the sheep farm at Pecket Harbour, where I was able to examine some fine moraines, which seem to mark the termination of the Magellanic glacier, and which must, I think, have been formed beneath the surface of the sea before the upheaval of that part of Patagonia. We likewise inspected the Catholic mission on Dawson island, where Cook was able to carry out some anthropological measurements among the Fuegians of the Onas tribe, whilst I took some linguistic notes.

In order to pass round Tierra del Fuego, the *Belgica* traversed Magdalena sound and Cockburn channel. We did not get sight of Mount Sarmiento, which was lost in the clouds, but we looked with

admiration on the superb glaciers which descend from the spurs of this mountain *massif*, some of which discharge themselves into the waters of the channel. At the entrance to Darwin channel we put into a small bay on Londonderry island, and on the opposite (Fuegian) side of the channel into a fine fiord, at the head of which debouches an immense glacier from the slopes of Mount Darwin. Here and there we saw well-preserved traces of the former extension of the glaciers. Thus, on Londonderry island, the entrance to the small bay, in which we had cast anchor, was fringed on both sides with fragments of moraines, one of which ran out in the form of a natural jetty.

A little above sea-level a lake occupied the bottom of the valley which debouched into the bay. This lake discharged by a torrent, the bed of which had been cut down into the rock of the sill which separated it from the bay. On the precipitous walls which bounded the funnel, at the bottom of which the lake lay, there were *roches moutonnées;* and higher up, above a second sill, was another smaller lake, which also seemed to occupy a basin hollowed out of the rock. In the Pleistocene period this valley must certainly have been occupied by an immense glacier. From the summit of a mountain 2300 feet high, I could make out that the whole of O'Brien island, which we had opposite us, was likewise strewn with small lakes ranged in line in accordance with the direction of the valleys. Other funnel-shaped hollows which we had seen from the deck of the *Belgica* while passing through Cockburn channel suggested to me that there must be lakes occupying basins abandoned by the ice on the retreat of the Pleistocene glaciers. They thus seem to form one of the characteristics of the region.

The bay of the great glacier on Tierra del Fuego is a superb fiord, into which we advanced as far as was possible, effecting landings at several points in order to study the flora and the geology. Three large transverse moraines divide the fiord into basins. The third moraine leaves only a narrow passage of no great depth, so that the last basin, into which the glacier debouches, is entirely packed with floating ice. It formed miniature icebergs, only the smallest of which can be carried by the current into the fiord and thence into Darwin channel. The doctor and I did our best to make our way to the glacier, which is truly magnificent. We climbed the heights, where we had to hug the extremities of several small hanging glaciers, and climb steep rocks, for along the margin of the basin there is no beach, while the cliffs are mostly precipitous, and to have forced a way among the ice in a canoe would have been an impossibility. In the end we were stopped by a river which flows from a lateral valley, and which we made no attempt to cross, the distance still separating us from the great glacier being too considerable and the ground virtually impassable.

The transversal moraines are not the only indications of the ancient

extension of the great glacier. They rather mark with great clearness the stages of a rapid retreat of this immense river of ice at the close of the glacial epoch. The sides of the mountains which border the fiord bear *roches moutonnées* at considerable altitudes, and one of the mountains has the characteristic outline of a huge sheep's back surmounted by a small hillock. This latter has sharp ridges, whilst all the rest of the mountain is polished and planed by the erosive action of the ice. I have no doubt that during the glacial epoch it was a nunatak rising above the surface of the inland ice which covered the Darwin mountains, and which certainly reached to this point. It was not merely, therefore, the head of the fiord which was blocked with ice, but the whole of this immense valley was buried in this outpouring of the inland ice, until only a few of the mountain summits remained above the surface of the icy mantle.

In Darwin channel we once more cast anchor, in a small bay named by the expedition Asterias bay, from the large number of crustacea collected there by Racovitza. Thence we proceeded direct to Ushuwaia in Beagle channel, whence the *Belgica* went on to Llopotaia fiord in order to take in coal. I went across the forest on foot, accompanied by two Indians, while Dr. Cook remained at the Protestant mission at Ushuwaia to make an anthropological study of the Yahgans. The scenery of Llopotaia fiord is grand. At its head rises a mountain, called the "Bonnet de la République," from the snowy cap which covers the summit; while quite on the horizon, through the wide opening afforded by a valley, the Darwin mountains can be clearly seen in fine weather, with the Pic des Français in front. These mountains are entirely unexplored, and even Lake Acigami, which ends at the settlement of Llopotaia, has never been visited. It was impossible, for want of time, to penetrate as far as the Darwin range, or even to ascend the Martial mountains, which rise just abreast of Beagle channel.

After returning to Ushuwaia, the *Belgica* proceeded to Harberton harbour, where we met with an accident which came near putting an end to the expedition. The *Belgica* struck a submerged rock, on which she remained fast. At low water the ship completely heeled over, and a storm that supervened added still more to the danger of our situation. But, fortunately, the swell that arose, and eventually became very strong, finally lifted the *Belgica* off the rock, after having beaten her against it for several hours. It was most astonishing that our ship had the strength to resist so many violent shocks, and the result was that, far from discouraging us, this accident only gave us confidence for the future.

As soon as liberated, it was in complete disorder on board that we made the best of our way to a good anchorage in which to take shelter. The captain cast anchor in Port Toro, on Navarino island, where we passed the night, and on the following day went back

again to Harberton harbour to take on board Dr. Cook, who had landed, and after a short stay, we started for Staten island. Our putting in here was rendered necessary by the fact that when aground near Harberton, we had been obliged to pump out all our stock of water to lighten the vessel, and, having been told that the water at John harbour was good and abundant, we seized the opportunity of visiting Staten island, which is of especial interest from a geographical point of view. The Admiralty chart shows that the form of this island is most curious. It is long and narrow, cut up by fiords and bays, and forms, in fact, a chain of mountains with a much broken relief, due to the powerful erosion to which it has been subject. But its base is wanting, and the sea encroaches everywhere on the bottoms of the valleys, so as to cut up the island into separate fragments. It is the skeleton of a mountain range emerging but slightly above the level of the sea.

Staten island forms one of the extremities of the Andes, which, curving towards the east, encloses within its bend the plains of Tierra del Fuego, while on the opposite side it falls steeply to the ocean. The chain of the Andes seems to open in the form of a fan, for if Staten island forms the prolongation of the Darwin and Martial ranges, there is another important ridge which runs south and ends at Cape Horn; and possibly also a third and outermost one, which extends to the islands of Diego Ramirez. It seems to me a natural question to ask if this is really the end of the great chain of mountains which borders the whole Pacific side of South America, or whether, on the contrary, the chain is prolonged in the form of submarine ridges beyond these limits. The existence of Burdwood bank shows us that the base on which Staten island rests is continued to the 53rd degree of longitude, but how is it to be traced beyond this point? Is it connected directly with the South Orkneys, or is the arc still wider, and do South Georgia and the chain of the Sandwich isles belong to the same system? Even before our departure I had been much puzzled to know in what direction the prolongation of the Andes was to be sought, and how the range was connected with the framework of the Antarctic lands situated south of the southernmost point of America, *i.e.* with the volcanic chain of the South Shetlands and Orkneys, and the great range which traverses the lands discovered by Palmer, Ross, and d'Urville, and is continued southward in Graham Land and Alexander Land, and, no doubt, further still towards the south, possibly as far as Mounts Erebus and Terror. And I am now still more puzzled than ever to know the correct solution of this problem of terrestrial morphology.

At the extremity of John harbour, where we anchored, I discovered glacial traces. There were morainic materials, and on the prolongation of the fiord there was a lake bordered by a moraine, while further up there was still another basin excavated in the rock. One of the employés at the lighthouse in John harbour, who has lived several

years on Staten island, assured me that there are many lakes among the heights, and pointed out the position of several of them on the map. At the present day there is not a single glacier on the island, but the traces of ancient glaciation explain clearly the peculiarly characteristic features of its relief.

The *Belgica* left Staten island on January 14, 1898, and it was from this date that our voyage of exploration began. As I have already stated, we had all the equipment necessary for oceanographical investigations, and I was happy to be able at last to commence my researches, which began with an interesting discovery. South of Staten island, in the latitude of Cape Horn, the sounding-lead only touched bottom at 2200 fathoms, and from this point the depths gradually diminish towards the south. It is, therefore, towards the east that I think we must look for the prolongation of the Andes, since south of Cape Horn we are still in the Barker basin. The Pacific ocean ought, therefore, to be extended beyond the meridian of Cape Horn, for its natural limit will certainly be found in the submarine ridge of the Andes.

4. *The Antarctic Lands.*—It was on January 23 that we reached Hughes gulf, the outlines of which are but vaguely traced on the Admiralty chart, from the indications supplied early in the nineteenth century by English and American whalers. We soon saw that the modern charts of Petermann and Friederichsen, intended to illustrate the discoveries of the German Captain Dallmann, were entirely at fault. As the information respecting the lands situated to the south of Cape Horn was extremely scanty, it was with pleasure that we all worked our hardest to collect such *data* as should be obtainable on the nature and extent of these lands. Captain Lecointe, assisted by Commander de Gerlache, was busy from morning till night on survey work, the *Belgica* being moved from place to place in order that all the details of the coast might be seen from near at hand; Dr. Cook was constantly at work taking photographs; Racovitza took notes on the animals and plants which he managed to collect; while I took every opportunity of landing to collect specimens of the rocks and study the glaciers of this region, besides taking numerous photographs.

Our geographical discoveries are already well known, and I will, therefore, not dwell in detail on our zigzag course through Belgica strait, which can be followed in my article on the Antarctic Lands published in the February number of the *Geographical Journal*. The chart constructed by Captain Lecointe gives an idea of the work accomplished during the three weeks devoted by the expedition to cartography, for it was on February 13 that we left the newly discovered lands to push our way south through regions until then completely unexplored. The important point which is brought out by Lecointe's map, is that the east coast of the strait traversed by us is perfectly continuous, and that its contours display the characteristic features of a region of fiords. Towards

the south this land (named by us Danco Land, in memory of Lieut. Emile Danco, who died during the course of the expedition) is connected with

FIG. 1.—CAPE ASTRUP: WIENCKE ISLAND, SEEN FROM NEUMAYER CHANNEL.
(*Photo by Arctowski.*)

FIG. 2.—SPECIAL FORMS OF GLACIERS SEEN ON WIENCKE ISLAND.
(*Photo by Arctowski.*)

Graham Land, the northern extremity of which was likewise explored by us. Towards the north, on the contrary, the continental coast-line was not traced by the expedition, for this would have necessitated

retracing our steps, while, the season being already far advanced, we had to continue our onward voyage to the south. But as the inland ice rises to a very considerable height east of Hughes inlet, I have been led to believe that land must reach in that direction as far as Louis Philippe Land. It therefore seems likely to me that the coast-line is continuous to that point, and that Louis Philippe Land is in reality the northern termination of Graham Land, and that the "New Greenland" of the first explorers of this region is not a phantasm. The large islands situated to the west of Belgica strait form an archipelago, which has been named Palmer archipelago, in order to give a place on the maps to the name of this intrepid American navigator.

It has been asserted that the discoveries of Palmer were nothing but a fable, and that the account of them given by Fanning * is mere imagination. Fanning writes as follows:—

"After the *Hersilia's* return from the South Shetlands, a fleet of vessels, consisting of the brig *Frederick*, Captain Benjamin Pendleton, the senior commander, the brig *Hersilia*, Captain James P. Sheffield, schooners *Express*, Captain E. Williams, *Free Gift*, Captain F. Dunbar, and sloop *Hero*, Captain N. B. Palmer, was fitted out at Stonington, Connecticut, on a voyage to the South Shetlands. From Captain Pendleton's report, as rendered on their return, it appeared that while the fleet lay at anchor in Yankee Harbor, Deception Island, during the season of 1820 and 1821, being on the look-out from an elevated station, on the mountain of the island during a very clear day, he had discovered mountains (one a volcano in operation) in the south; this was what is now known by the name of Palmer's Land. From the statement it will be perceived how this name came deservedly to be given it, and by which it is now current in the modern charts. To examine this newly discovered land, Captain N. B. Palmer, in the slope *Hero*, a vessel but little rising forty tons, was despatched. He found it to be an extensive mountainous country, more sterile and dismal, if possible, and more heavily loaded with ice and snow, than the South Shetlands. There were sea-leopards on its shore, but no fur seals; the main part of its coast was ice-bound, although it was in the midsummer of this hemisphere, and a landing consequently difficult.

"On the *Hero's* return passage to Yankee Harbor she got becalmed in a thick fog between the South Shetlands and the newly discovered continent, but nearest the former. When this began to clear away, Captain Palmer was surprised to find his little barque between a frigate and sloop of war, and instantly ran up the United States flag; the frigate and sloop of war then set the Russian colors. Soon after this a boat was seen pulling from the commodore's ship for the *Hero*,

* Edmund Fanning, 'Voyages round the World, with Sketches of Voyages to the South Seas' (New York, 1833), p. 434.

and when alongside, the lieutenant presented an invitation from his commodore for Captain P. to go on board; this of course was accepted. These ships, he then found, were two discovery ships sent out by the Emperor Alexander of Russia, on a voyage around the world. To the commodore's interrogatory if he had any knowledge of those islands then in sight, and what they were, Captain P. replied he was well acquainted with them, and that they were the South Shetlands, at the same time making a tender of his services to pilot the ships into a good harbour at Deception Island, and nearest by where water and refreshments such as the island afforded could be obtained. He also informed the Russian officer that his vessel belonged to a fleet of five sail out

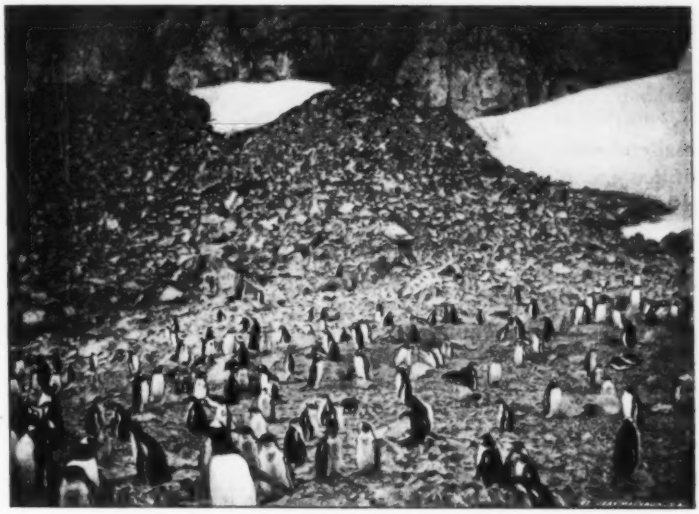


FIG. 3.—A ROOKERY OF SMALL PENGUINS, PYGOSCELIS PAPUA.
(*Photo by Racovitza.*)

of Stonington under command of Captain B. Pendleton, and then at anchor in Yankee Harbor, who would most cheerfully render any assistance in his power. The commodore thanked him kindly. 'But previous to our being enveloped in the fog,' said he, 'we had sight of those islands, and concluded we had made a discovery; but behold, when the fog lifts, to my great surprise, here is an American vessel apparently in as fine order as if it were but yesterday she had left the United States; not only this, but her master is ready to pilot my vessels into port. We must surrender the palm to you Americans,' continued he, very flatteringly. His astonishment was yet more increased when Captain Palmer informed him of the existence of an

immense extent of land to the south, whose mountains might be seen from the masthead when the fog should clear away entirely. Captain Palmer, while on board the frigate, was entertained in the most friendly manner, and the commodore was so forcibly struck with the circumstances of the case that he named the coast then to the south Palmer's Land.* By this name it is recorded on the recent Russian and English charts and maps which have been published since the return of these ships. The situation of the different vessels may be seen by the plate; they were, at the time of the lifting of the fog and its going off to the eastward, to the south, and in sight of the Shetland Islands, but nearest to Deception Island. In their immediate neighbourhood were many ice islands, some of greater and some of less dimensions, while far off to the south the icy tops of some two or three of the mountains on Palmer Land could be faintly seen. The wind at the time was moderate, and both the ships and the little sloop were moving along under full sail."

This meeting was also described by Bellingshausen himself, as can easily be seen by consulting the remarkable, but still little-known work of that eminent Russian explorer.†

Further on we read ‡—

"The following season, in 1821 and 1822, Captain Pendleton was again at Yankee Harbor, with the Honington fleet; he then once more despatched Captain Palmer in the sloop *James Monroe*, an excellent vessel of upwards of 80 tons, well calculated for such duties, and by her great strength well able to venture in the midst of and wrestle with the ice. Captain Palmer reported on his return, that after proceeding to the southward, he met ice fast and firmly attached to the shore of Palmer's Land; he then traced the coast to the eastward, keeping as near the shore as the ice would suffer; at times he was able to come along shore, at other points he could not approach within from one to several miles, owing to the firm ice, although it was in December and January, the middle summer months in this hemisphere. In this way he coasted along this continent upwards of fifteen degrees, viz. from 64 and odd down below the 49th of west longitude. The coast, as he proceeded to the eastward, became more clear of ice, so that he was able to trace the shore better. In 61° 41′ south latitude, a strait was

* "This continent," it is asserted in Morrell's 'Voyages,' p. 69, "was named 'New South Greenland,' by a Captain Johnson. It is but just to state here, that this most meritorious mariner (Captain Johnson) was a pupil to, and made his first voyage to the South seas with, the author, with whom also he remained, rising to different stations, and finally became one of his best officers. The first information he obtained of the discovery of this land by Captain Pendleton and Palmer was from the author of this work."

† 'Dwukratnyja izyskanija w jushnom Lèdowitom okeanie' (St. Petersburg, 1831), vol. ii. pp. 263, 264.

‡ Fanning, p. 438.

discovered [South Orkneys], which he named Washington Strait; this he entered, and about a league within, came to a fine bay which he named Monroe Bay. At the head of this was a good harbor; here they anchored, calling it Palmer's Harbor. The captain landed on the beach among a number of those beautiful amphibious animals, the spotted glossy-looking sea-leopard, and that rich golden-colored noble bird, the king penguin. Making their way through these, the captain and party traversed the coast and country for some distance around, without discovering the least appearance of vegetation excepting the winter moss. The sea-leopards were the only animals found; there were, however, vast numbers of birds, several different species of the

FIG. 4.—OSSIFRAGA GIGANTEA. SEVENTEENTH LANDING, BOB ISLAND.
(*Photo by Arctowski.*)

penguin, Port Egmont hens, white pigeons, a variety of gulls, and many kinds of oceanic birds. The valleys and gulleys were mainly filled with those never-dissolved icebergs, their square and perpendicular fronts, several hundred feet in height, glistening most splendidly in a variety of colors as the sun shone upon them. The mountains on the coast, as well as those to all appearance in the interior, were generally covered with snow, except when their black peaks were seen here and there peeping out." *

* This second part is evidently exaggerated, the discovery and the cartography of the South Orkneys being the work of Powell. Their discovery is described by Powell himself in the *Journal des Voyages, découvertes et navigations modernes ou Archives Géographiques du XIX^e. siècle*, tome xxii. (Paris, 1824), p. 93: "Extrait du journal du voyage du capitaine Powell, à South-Shetland, pendant les années 1821 et 1822."

It is to be regretted that after the voyage of the German whaling captain Dallmann, the German "armchair geographers" devoted themselves so keenly to the cartography of this region that they did not hesitate to criticize the map of Lecointe, and, in *Petermanns Mitteilungen*,* to treat de Gerlache as an ignoramus. Taking advantage of the fact that Smiley, in 1842, effected a circumnavigation of Palmer archipelago, they indulged in unlimited speculation on Dallmann's *Notes de Voyage*, and "discovered" the King William archipelago and Bismarck strait, which, according to circumstances, can either stretch south-east, east, or north, and which is also the *raison d'être* of that other unfortunate innovation, the Dirk Gerritsz archipelago. Now, the fragments of Dallmann's Journal, which have been published, in no way permit the conclusions necessary for the construction of a new map, and in my opinion the Admiralty—whatever they may say in Germany—has done quite right to pay no attention to the elaborate maps of Friederichsen and Stieler's Atlas. The King William islands are, as a matter of fact, nothing but a part of the Biscoe islands, placed, with exaggerated dimensions, much too far to the east, far inland. As to the strait, Dallmann could not, from his position, have seen anything other than the entrance to the great fiord called by de Gerlache, Flanders bay. Besides, Dallmann, who navigated Hughes gulf, clearly describes Hughes inlet (of Lecointe's map), but, not having advanced sufficiently far, did not discover the northern entrance of Belgica strait. Therefore, if, as is contended in *Petermann's Mitteilungen*, the name Belgica strait ought to have no place on the map, it is Smiley's name that ought to be inserted, rather than that of Prince Bismarck, who never made a voyage of discovery.

There is one other point to which I wish to call attention. Demas, one of Dumont d'Urville's officers, says † that he noticed that Orléans channel extended towards the south-west. It may well be, therefore, that Dallmann passed through Orléans channel, when he discovered that Trinity land was an island. Trinity island is, therefore, the last large island of Palmer archipelago.

The general map of the lands to the south of America must, as we have just seen, be drawn quite differently from its delineation by the Germans. We have there a large peninsula (of the antarctic continent,

---

On page 111 we read in a note, "On ne peut dire que fort peu de chose sur la terre du S., appelée Palmer's land, attendu qu'elle n'a pas été suffisamment explorée; mais on la représente comme fort elevée et toute couverte de neige. On y voit aussi des entrées en forme de détroits, qui divisent probablement la terre, et constituent des rangées d'îles semblables à celles de South Shetland. Tel est, en un mot, l'aspect de la côte N., qui seule a été aperçue."

* *Pet. Mitt.*, 1900, p. 172; 1901, p. 48.

† Dumont d'Urville, 'Voyage au Pôle Sud et dans l'Océanie' (Paris, 1842), vol. i., 2de partie, p. 338.

if such a continent exists), which terminates northward in a point facing north-east. A series of islands fringe this land on the side of the Pacific. They are, first Biscoe islands, and further north the Palmer archipelago. Another archipelago (the South Shetlands), forming a well-marked chain of mountains, stretches for some distance to the north in a north-east by east direction. It is noteworthy that taken as a whole these lands present a striking analogy with the southern extremity of America, and as the Andes are continued towards the east, so also the mountains which form the backbone of these southern lands reappear above the level of the sea a little to the east of the South Shetlands, in the South Orkneys.

The antarctic lands which we visited are very mountainous, and the mountains reach to the shores almost everywhere. The region of Belgica channel bears the characters of a depressed area, so much so that in spite of one's self one is driven to the conclusion that the whole block has sunk into the sea, under the pressure produced by the accumulation of ice, to a depth sufficient to restore equilibrium. By reason of this ice, which seems to be piled up in quantities almost as great as the extent of the lands permits, the relief of the ground is almost completely masked. Still there are valleys blocked by immense streams of ice, and in these valleys there must be sills, since ice-falls are to be seen here and there. Cirques too occur; so that we find all the forms characteristic of fluviatile erosion, and I feel no doubt at all that before the glacial epoch this region was clear of ice, and that the traces of relief noticed were produced by running water. This relief can, however, be only guessed at, at the present day, for the eternal snows have accumulated everywhere, and it is only by the directions of the glaciers and the external forms of the snow-fields, as well as by the crevasses, that we can picture to ourselves the form of the ground on which these ice-masses rest.

Still, it is possible to trace some of the broad lines of the irregularities of the relief, due to tectonic causes. The two principal islands of Palmer archipelago are traversed in the direction of their length by a chain of mountains having a well-defined direction from south-west to north-east, with, I believe, a gentle curvature to the east. The Biscoe islands certainly form the southern prolongation of this chain, while Trinity island is possibly that to the north-east. Moreover, from the few geological data which I could collect, this line of mountains forms likewise a zone of ancient eruptive rocks, with one or more volcanoes of tertiary, or possibly even of recent date. Wiencke island and the northern point of the coast of Graham Land form a similar chain which runs in a direction parallel to the first. As regards the mountains of Danco Land, they form more important *massifs* of granites, metamorphic and sedimentary rocks, while further inland there are also some masses of gneiss, as is shown by the erratics derived from that part of the country.

I am led to believe that the more detailed study of the geology of this "New Greenland" of the first navigators will bring to light analogies between the mountain system of these lands and that of the chains which form the southern extremity of the Andes, and that we are now in a position to formulate and discuss the theory of the "Antarctic Andes." The petrographic study of the rocks which I brought back will give us some data to work from. I propose to call this system of mountains the Copernicus range, and in this way to introduce, into our geographical maps, the name of the immortal Polish astronomer.

5. *The Antarctic Glaciers.*—The glaciers of the antarctic lands visited by the expedition are very characteristic, and differ so completely in appearance from the alpine, or even the arctic glaciers, that it would be difficult to describe them in a few words. The line of perpetual snow running very close to the level of the sea, and in places even at that level, one of the special features of glaciers, which is quite the rule in the case of those of the Alps and arctic regions, is completely wanting to the antarctic glaciers. The terminal portion of the ice-stream—that in which it is laid bare and melts under the influence of solar radiation and the higher temperature of the lower regions to which it has descended—which we have come to regard as quite characteristic of glaciers, is altogether or almost entirely absent. To their very extremities they are, in fact, included within the region of accumulation of snow—the zone in which they are continually enriched by the contributions made by atmospheric precipitation. This fact alone permits the occurrence on the antarctic lands of special types of glaciers, the most remarkable of which is that of ice-caps. The study of the alpine glaciers has led geologists to distinguish only the three forms of "valley glaciers," hanging or "corrie glaciers," and "regenerated glaciers." The idea of a glacier thus presupposes the presence of a valley. This idea is a mistaken one, for it is quite possible that the ice-stream may be wanting. This is the case in the Antarctic whenever it happens that the collecting-ground is sufficiently near the coast for the glacier to terminate at its greatest breadth in an ice-wall. In the antarctic regions perpetual snow can exist on level ground in so low a latitude as 65°, so that even small islands may bear a complete mantle of perpetual snow. On some small islets of less than a mile in diameter, we found a thick accumulation of ice entirely covering the inequalities of the ground, and forming in consequence convex glaciers. These ice-caps ended seawards in perpendicular walls, whilst on the surface they took the form of huge, perfectly even sheep's backs.

It is evident that this form of glacier will be found also on islands of larger extent, whenever the relief is sufficiently uniform to make it impossible for a peak to pierce through the glacial cap. As regards the thickness of these caps, it is plain that it depends on the plasticity of the ice and the extent of ground on which it rests. To my

mind the only difference which exists between these convex glaciers of the antarctic and the inland ice of Greenland consists in the incomparably greater extent of the latter, and in the fact that this does not reach the coast, but melts up into streamlets, and sends glaciers down towards the sea only through the valleys. But it is possible that there may be a sheet of inland ice more extensive even than that of Greenland. We may say that the great ice-cap supposed by Croll * may quite well cover the antarctic continent, since even small islands are seen to have the even and convex covering of ice laid down by Croll for the whole southern continent.†

On the other hand, it may seem surprising that the glacial caps are

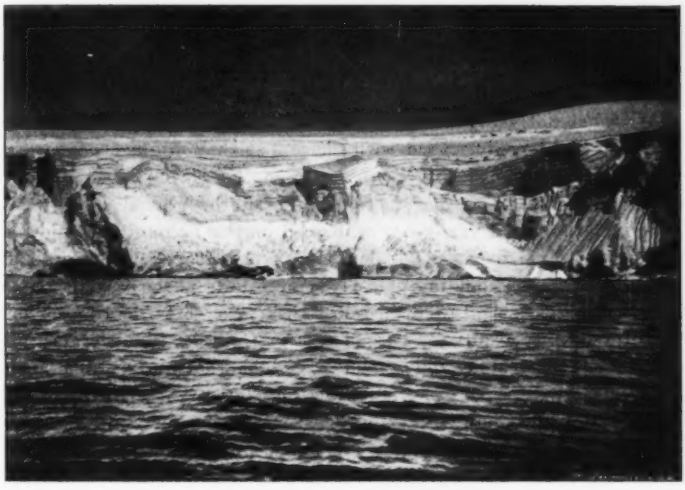


FIG. 5.—A CHARACTERISTIC ANTARCTIC COAST: FLAT GLACIER TERMINATED BY AN ICE-WALL, SHOWING STRATIFICATION OF THE NÉVÉ.

(*Photo by Cook.*)

not the sole type of glacier in these regions, where the line of perpetual snow is found at sea-level.‡ The reason is that most of the islands are

* 'Climate and Time,' 4th edit. (London, 1897), p. 374.

† Cf. Arctowski, "Les calottes glaciaires des Régions Antarctiques," *C. R. Acad. Sci. Paris*, December 24, 1900.

‡ The question of the level of perpetual snow in the region of Belgica strait is a very complex one. Prof. Penck, who was present at an address that I delivered at the "Naturforscher-Versammlung" at Aix-la-Chapelle, was tempted to suppose that there might well be two lines of perpetual snow, one above the other, in that region. Low-lying fogs are, in fact, very frequent there, and these protect the snow from the effects of solar radiation, while, on the other hand, the clouds which most frequently give rise to atmospheric precipitation likewise rest very low. The summits and upper portions

too high in proportion to the area occupied by the base, and that therefore the mountains cannot fail to pierce through the coating of ice. The antarctic glaciers are not stationary, any more than those of other regions, and though they remain perpetually under the sway of winter, they still move on. The plasticity of the ice prevents its accumulation beyond a certain limit of height, and the mantles of ice must—even under extremely rigorous conditions of weather—be limited in thickness, while all the forms of the antarctic glaciers must be those of a semi-fluid mass. There are thus both ice-rivers and cascades, and also forms recalling the "corrie glaciers." But all are alike buried beneath a mantle of perpetual snow, and bare ice is nowhere seen. "Inland ice," properly speaking, does not exist on the large islands of the Palmer archipelago. On the other hand, on Danco Land and Graham Land, it is only the mountains situated near the coast which show themselves, while the whole interior of the land lying eastward is completely buried under the inland ice.

We must not, however, imagine that the antarctic lands are at the present day as heavily loaded with glaciers as they might be, for traces of a wider extension, dating doubtless from the glacial epoch, are still preserved. The presence of these vestiges of the glacial epoch seems to me remarkable for various reasons, and on this account I should like to bring forward some facts in support of my assertion. Gaston islet, our eighth antarctic landing-place, lying a mile from the coast, is a huge *roche moutonnée* perfectly polished on the surface. At the time of our visit it was almost entirely bare of snow. Opposite this islet, at Cape Reclus, there rises, along the coast, a large moraine running from north-east to south-west. An examination of the map of the lands discovered by the expedition shows that the direction of the moraine is that of Belgica strait, and we are led to the conclusion that the glacier which produced this moraine must have occupied the strait itself, which has at this point a breadth of 10 miles and a depth of 342 fathoms. Another argument is supplied by our seventeenth and eighteenth landings. On Bob islet, not far from Wiencke island, we discovered some well-preserved fragments of a moraine, from 15 to 20 feet high, resting against the sloping shore at a height of 80 feet above the sea. This moraine has the same direction as the channel, and its height decreases gradually towards the west. On it were some huge blocks of gneiss perfectly polished. The red granite is in the form of rounded boulders, and the same is the case with other rocks, while the diorite is often angular.

---

of the flanks of the mountains (1000 feet and over) are therefore subject to a climatic *régime* decidedly different from that which prevails at sea-level. The mean temperature of the air is possibly lower, but on the other hand the amount of atmospheric precipation is less and the effect of radiation greater. This would explain the fact that the mountain slopes are sometimes bare of snow at an altitude of 1500 feet or even higher. It follows that the idea of two levels of perpetual snow is quite a plausible one.

On the other side of Belgica strait, exactly opposite the former spot, we discovered a fine moraine on Banck island. Its height was 65 feet, and its direction parallel to that of the strait. It rested against the sloping side of the mountain, which here displayed characteristic *roches moutonnées*. These moraines can only be explained as the product of an immense glacier which must have flowed through Belgica strait westward, *i.e.* towards the Pacific ocean. Other proofs of the former wide extent of the antarctic glaciers are furnished by the erratics collected in Hughes gulf, at our third, fifth, and sixth landings, as also by those found on Antwerp island at the fourteenth landing-place, where a bank of rolled pebbles and blocks extends for a certain distance from the shore. Further, in Errera channel, a remarkable moraine runs transversely across. Lastly, we frequently saw perfectly polished *roches moutonnées*, either along the shore-lines or on small islands.

The discovery of the former greater extension of the antarctic glaciers seems to me so important a fact to record, that I could not refrain from entering into these details. The discovery is interesting from various points of view. I will here merely call attention to a question which seems to me closely bound up with it—I allude to the climate of the glacial epoch. In fact, this question aroused a keen interest in me, from the moment when I noticed the morphologic analogy which exists between the southern extremity of South America and this northern point of the antarctic continent, and which suggests the question whether the more thorough study of the climates of the two regions and of the glaciers might not permit us to calculate the point to which the mean temperature of the air must have fallen during the glacial epoch.

This epoch has left its mark in both regions, and the aspect presented by the antarctic lands in our day seems to afford an indication of the condition of the channels of Tierra del Fuego during the glacial epoch. We are, therefore, justified in asking whether the existing climate of the antarctic lands in 64° may not be the same as that which prevailed in 54° during the ice-age.*

I am confident that the investigations of the next antarctic expeditions which may visit the two regions will furnish us with the key to the problem here indicated.

6. *Antarctic Icebergs.*—The icebergs of the arctic regions are, in general, of very varied form, and usually of small dimensions, although heights of 80 metres (260 feet) are frequently measured, and it seems that as much as 110 metres (360 feet) above sea-level may be attained.†

* H. Arçtowski, "A propos de la question du climat de l'époque glaciaire," *Ciel et Terre*, March, 1901.

† E. V. Drygalski, 'Grönland Expedition,' vol. i. p. 381.

The tabular form has rarely been recorded, although the icebergs do show it near the glaciers from which they are derived, if the slope of the glacier is slight and the berg retains its original position of equilibrium after detachment.

The antarctic, on the other hand, is the region of immense tabular icebergs. In the southern seas, bergs several kilometres in length, and rising to a height of 60 metres (200 feet), have been frequently met with; ice-islands rising to as much as 500 metres (1640 feet) have been reported, but this is obviously a gross exaggeration. Erroneous views about the antarctic icebergs are very widely held.* Heim, for example, states that they are of marine origin, formed by successive thickenings of the ice-pack.

FIG. 6.—TABULAR ICEBERG WITH GROTTOES.
(*Photo by Cook.*)

In the seas navigated by the *Belgica*, we have seen as many as a hundred and ten icebergs at once, distributed all round the horizon. Forty per cent. of these would be of the characteristic tabular form, while the remainder resembled arctic bergs, or some form derived from the tabular. Large icebergs were rare; heights of 50 metres (164 feet) were quite exceptional, and the tabular bergs averaged only 30 to 40 metres (98 to 131 feet). The tabular icebergs are covered over with *névé*, and only show the alternate blue and white bands at the base. I only once had an opportunity of examining this stratification, in an iceberg which was enclosed in the pack, and displaced so that the strata dipped at a considerable angle. Both the blue and white bands were formed of glacier ice with the characteristic grained structure; the strata were not sharply separated from one another, the only difference between blue

* A. Heim, 'Gletscherkunde,' p. 270.

and white being that the ice in the latter was more porous, enclosing a large number of air-bubbles; the ice in both was compact. The supposition that tabular bergs are formed of sea-ice is entirely wrong. The mode of formation of the sea-ice shows that its thickness constantly tends to a limit, supposed by Weyprecht * to be 7 metres (23 feet) at a maximum, however low the mean winter temperature, and however great the number of years. I think Weyprecht's limit is too great for the antarctic regions. In any case, the continental origin of the antarctic icebergs is indisputable, for the bed of the Antarctic ocean is covered with terrigenous deposits and erratic blocks laid down by the melting of the ice, and these materials are transported to great distances from the glaciers from which they are derived.

FIG. 7.—THE EDGE OF THE PACK.
(*Photo by Cook.*)

The majority of the great antarctic glaciers have a sufficiently gentle slope to produce icebergs of tabular form. It is probable, however, that most of the ice-tables do not come from these glaciers, but from the wide ice-cap which form the inland ice covering the low-lying land situated farther south. Both our soundings † and those of Ross have shown that the continental inland ice does not extend (on the continental shelf) beyond the isobath of 400 metres (1312 feet), and this may be taken as the maximum total thickness of the icebergs coming from the pole in the whole antarctic area of the Pacific. If one-eighth of the tabular icebergs appear above the surface, we get 50 metres (164 feet) as the limiting height of the bergs detached from the great ice-

* K. Weyprecht, 'Die Metamorphosen des Polareises,' p. 139.

† H. Arctowski, "The Bathymetrical Relations of the Antarctic Regions" (*Geog Journ.*, July, 1899).

barrier known to extend from Victoria Land to long. 170° W., and which doubtless continues eastwards to the land to south and west of Alexander Land.

7. *Attempts to penetrate the Pack.*—As soon as the *Belgica* entered the Pacific ocean, the surveys of the strait discovered being completed, and the season already well advanced, Commander de Gerlache was impatient to push his way as far south as possible. He hoped to attain a high latitude, being convinced of the existence of an open navigable sea, like those discovered by Weddell and Ross, beyond the zone of the pack. We could have explored the coast of Graham Land, and we could have effected a landing on one of the Biscoe islands, which would have added materially to our knowledge of the geology of the antarctic lands. As we were in sight of Alexander Land, it would also have been easy to ascertain if this land is continuous with Graham Land; in other words, whether the apparent break between the two is a strait or only the entrance to a fjord. But de Gerlache did not wish to lose time, and set his course to south-west, in order to cross the pack, which we entered. We were already south of Bellingshausen's route, and unexplored regions lay before us to west and south. In the light of the experience gained since, it is apparent that it would have been better to have followed the edge of the pack, and to have entered the ice much further to the west; but those things cannot be foreseen, and we made our first attempt in long. 80° W. The ice was very thick, and after a few miles' navigation in the pack further progress was hopeless, and we had to turn back.

A second attempt proved equally vain. In long. 81° W., we did not reach the 70th parallel. In long. 85°, however, the edge of the pack was more to the south, and on February 27 we reached lat. 70° S. without difficulty, the ice being navigable, and, aided by a gale, we made rapid progress. Here the pack was distributed in bands of ice but little compressed, and having free spaces of varying width between, through which the *Belgica*, driven by the wind, could break a passage. Finally we came to the close pack, which was quite impenetrable. With powerful machinery we could no doubt have proceeded further, but the *Belgica* became altogether immovable in lat. 71° 30′ S., on March 2, 1898. This latitude was never exceeded later by more than a few minutes.

No serious attempt was made to escape from our imprisonment. Wintering in the antarctic regions was part of the programme of the expedition, and it was just as well to do so where we were, in the moving pack, as to force a way out and return to a land station. Besides, in the explored land regions, we had only seen one place where wintering was practicable—at the twelfth landing in Lemaire channel.

The first days of our sojourn in the ice were very trying. Everyone naturally asked himself how long we were to remain, whether we were one day to escape and return home safe and sound, or whether

the pressure of the ice would crush our vessel, with consequences no one could foresee; every one regretted the work unfinished, and feared for the loss of the materials and observations already collected. But we became accustomed to our surroundings very quickly. On March 6, Amundsen, Cook, and I left the ship, and, going from one floe to another by jumping the narrow open channels between, made our first excursion. The weather was fine, and it was a pleasure to risk a visit to an iceberg, which, like ourselves, was a prisoner in the pack. The floes were small, and constantly moving, so that the recurring risk of jumping short and falling into the water added a spice of adventure to our journey. But all went well, and a very agreeable day gave us confidence in ourselves and hope that we should not lack means of amusement.

The seals and penguins were our very good comrades from the

FIG. 8.—ATTEMPT TO PENETRATE THE PACK.
(*Photo by Arctowski.*)

beginning; they took the greatest interest in all our affairs. The penguins, particularly the small ones (*Pygoscelis Adeliæ*), seemed to us remarkably intelligent, and we took great interest in watching them. They had an almost human appearance when walking across the snow, and, indeed, they had many human attributes, especially in their social customs.

We often met companies of six or eight or more penguins promenading on the pack in the sunshine. When they saw us they generally exhibited curiosity, and approached to get a nearer view. I do not know if these birds have the instinct of the naturalist, and take a lively interest, doubtless purely philosophic from their point of view, in everything new which presents itself, or if the object of their investigations is entirely practical, but they certainly came near

us with a distinct purpose of making examination. But if we had the misfortune to excite much curiosity, they became aggressive. One would first come close to us and reconnoitre, and then, on his order, the others would advance with a menacing air, and the battle began—a battle in which we sometimes had trouble to demonstrate effectively our superior strength. On one occasion we were able to observe that the penguins are musical amateurs. Unfortunately, we could not ascertain if they are equally able to appreciate "talent and classical music," for we had no *virtuoso* amongst us, nor indeed any musician, although we all, without exception, played numerous melodies and even operatic airs on the ship's barrel organ. But in any case—and the thing is worth noting—one of the sailors delighted to exercise himself upon the trumpet, and the penguins came from great distances to listen to him —no doubt to learn something new.

Often, very often, these brave penguins amused us, and when we were tired of preserved foods, specially with the Australian rabbits, they afforded us real succour, after we learned that the flesh of penguin is excellent eating. It is to be imagined that our existence in the pack was not of the gayest, however. Far from being ideal, the life of the polar explorer is often sad and monotonous. In the region where we were storms are frequent, and failing storms, fogs and snow-drift often rendered excursions impossible, and sometimes we were unable to walk about even close to the ship. Then at times the ice would open up, and the floes press against each other and break into fragments. These squeezes were most uncomfortable to watch when in the immediate neighbourhood of the ship, and hearing the grinding of the ice, the groans of the ship, and the trembling of the rigging as she rose and fell again, we experienced sickly sensations which may be imagined—we realized the gulf which separated us from the abysses of the ocean, and we longed for the land.

The *Belgica* was only once seriously nipped during the autumn months; but she held out, and the ice, which broke under the pressure on the starboard bow, went under the hull. The pack took a long time to consolidate. Whenever the wind fell the floes united, and the snow-drift over the surface of the ice helped to transform it into an unbroken plain. But as soon as the wind sprang up, the ice gave way again. Thus it was only with the cold, as it became more and more intense, that the floes consolidated. The ruptures grew further and further apart, and our situation became gradually more secure. Ultimately the *Belgica* was fixed in the middle of a field of ice, to which she was attached as if built in it; this we called "our floe." After this it was only from afar that we heard the noise of the ice after the wind had ceased to howl in the rigging, and the ice was yielding to pressure. And often in the silence of the night, lying in my berth, I put my ear to the wall and listened to hear what was happening a long way off.

8. *Investigations.*—I observed the *aurora australis* for the first time on March 14, when I witnessed a remarkably fine display, which impressed me greatly. The play of light was extremely varied, exceptionally so in this particular case, and the phenomenon presented a most imposing spectacle. The horizon amongst the ice was entirely free; we had the whole vault of heaven before us. I will not again describe the scene, but will refer those who are interested to my preliminary notices, and to the special memoir on auroræ published in the reports of the *Belgica* Expedition.* As the last-named publication is still in the press, I may give some notes on our scientific work generally. As soon as we had definitely resolved to winter in the antarctic, we had to organize an observing station. This station was not fixed. Our floe turned so as to displace the bow of the ship, but only slightly, and ultimately the direction remained—in spite of the drift—almost constant. The icebergs visible on the horizon had a motion scarcely different from our own; we kept them in sight nearly the whole time. During the drift the floes usually moved *en bloc* over a wide space, but occasionally they changed their positions (after a strong drift), so that one occupied an entirely different place relatively to its neighbours. This was at least the case as shown by the icebergs, which were fixed in the floes in the same way as the *Belgica*.

Lecointe made frequent astronomical determinations of position, and deduced therefrom the direction of drift. For this purpose a wooden hut was erected on the port side of the ship, quite close to it, and electric communication was established so that Dobrowolski could note the chronometer on board, while Lecointe himself observed the stars in the artificial horizon. During his observations in "his observatory" Lecointe was certainly sheltered, but as he often remained there without moving, he generally returned on board with his fingers half frozen. We were always eager to hear the result of the calculations. On May 31 Lecointe announced lat. 71° 36′ S., the highest we attained during our drift. Sometimes we moved northward with southerly or south-westerly winds—this we heard with joy; but with change of wind we would again go towards the pole, or eastward or westward, and so we wandered from place to place, sometimes back in our old position, sometimes far to the westward. Apparently we remained immobile, for everything round us followed the same course; we always took our dreary scenery with us. The drift of the *Belgica* with the ice is the longest experienced by any vessel; the chart shows that the movement of the pack was guided by an obstacle to the east and south of us, and the existence of land in those directions is further indicated by our soundings. Depths diminished to the south and east, and my

* H. Arctowski, "Aurores australes" ('Rapports scientifiques sur les résultats du voyage du S.Y. *Belgica*').

bathymetrical chart, published in the *Geographical Journal*, shows that during nearly all the time we were on a continental plateau. The pack in which we were may be regarded as a coastal pack, no doubt of great extent, but different in every respect (especially with regard to its movements) from the pack of northern polar regions. It is possible that in some years the pack becomes detached like that in the Ross sea, but the observations of Cook and Bellingshausen, as well as our own, in 1898 and 1899, indicate that this must be exceptional. I am of opinion that the great Graham Land peninsula forms an anticyclonic region, so that, far from driving the ice towards the ocean, the prevailing north-easterly winds of the summer months send it southward; but in the Ross and Weddell seas the same anticyclonic winds produce the opposite effect, because, as they come from south-east, they are diverted towards the north, Victoria Land being, in all likelihood, equally a region of high pressure. The forthcoming English expedition should decide this question.

On board the *Belgica* I took every opportunity of making soundings; the soundings were usually accompanied by observations of temperature, and the collection of samples of water for the estimation of density.

Racovitza made frequent use of the vertical net for the collection of plankton; and, thanks to the drift, he was also able to explore the bottom. He employed the trawl, with swabs, and was but little satisfied because these cumbrous appliances were brought up, after much labour, filled with pebbles which only went to enrich my geological collection, about which he cared little! The antarctic plateau is entirely covered with boulders, brought by the icebergs from distant land, and the sediments are for the most part terrigenous. But Racovitza's take did not consist exclusively of pebbles; he obtained good hauls of animals entirely new to science, and, as everything was carefully preserved, he has brought back a collection of great value. His treasures are now in the hands of competent specialists, and will furnish an important contribution to biogeography.

Our lamented Danco, who had constructed an observatory on the pack, did his best to obtain reliable observations of the magnetic elements, under the unfavourable conditions.

The hourly meteorological observations carried on by Dobrowolski and myself formed our principal occupation. When it snowed, the snow-crystals were examined and described; when there were clouds (particularly cirrus), Dobrowolski attempted to follow all their transformations, and especially to ascertain the direction of movement; and any optical phenomena were studied with the greatest care. Thus the days passed, not too quickly sometimes, in constant and assiduous labour.

9. *The Wintering.*—On May 17 we saw the sun for the last time. According to calculation, the centre of the sun was 40′ below the horizon

at noon on that date, and it was, therefore, because of refraction that we were able to observe half the disc, travelling along the horizon, for over an hour. For reasons which I am unable to explain, the appearance presented by the sun was very variable; at one moment it seemed flattened, almost square, at another notched and jagged. Such anomalies in the refraction of objects on the horizon are often observed in the polar regions.

From this day, we were not to see the sun again for two months. At the beginning we did not dread the prospect of this long polar night before us, but before the sun had been gone many days one of us became very ill. Danco lacked the constitution to hold out, and on June 5 he died. It is useless to dwell on sad recollections. He was loved on board the *Belgica*, and this loss, following on the death of the sailor Wiencke, who was washed overboard by a wave in Bransfield strait, made a deep impression on us. In the obscurity of the midday twilight we carried Danco's body to a hole which had been cut in the ice, and committed it to the deep. A bitter wind was blowing, as with bared heads, each of us silent and sad, we left him there . . . and the floe drifted on.

In the antarctic regions, thanks doubtless to the detestable climate, the disastrous effects of the polar night are far more marked than in the north. There is a general lowering of the system, and the heart acts feebly. Several of us developed serious symptoms, and without daily care on the part of the doctor, others would not have survived the period of darkness, though it was relatively short. One part of Cook's treatment was very effective and ingenious. Those who were most affected by deficient circulation were made to stand in a half-naked condition close to the red-hot stove, for several hours daily. In this way the action of the solar radiation was in part replaced by rays of artificial heat—in a manner admittedly primitive, but none the less beneficial.

Life on board during the polar night was of great interest from a psychological point of view. One finds one's self in conditions of existence altogether abnormal, and crowded against one's fellows in an uncomfortably narrow space. Some became nervous, excitable, and sleepless, with the imagination continually wandering and dreaming. I was one of these. Others, more happily constituted, became chronically tired and indifferent; these slept much. But everybody was content to spend twelve hours a day, or more, in bed. One of the crew developed maniacal tendencies; another, in more evil case, was brought home insane. Since the return of the expedition, one of our best men, Knutsen, has died, doubtless from heart disease contracted in the antarctic.

On board the *Belgica* we tried to amuse ourselves, during the dark days of winter, as best we could. We read much, but our library was

inadequate. Personally, I should greatly have liked an encyclopædia, and some Polish tales; a single volume of Sienkiewicz, which I happened to have with me, was read and re-read with great pleasure. We spent our evenings playing cards, and although I have always had a great aversion to cards, and indeed to games in general, I confess to pleasant hours spent at whist. We had to play for something, and as we had no money, we gave notes of hand (which we had not the remotest intention of honouring) for sums of 100 to 10,000 francs, and risked the most hazardous combinations. Sometimes the bank held

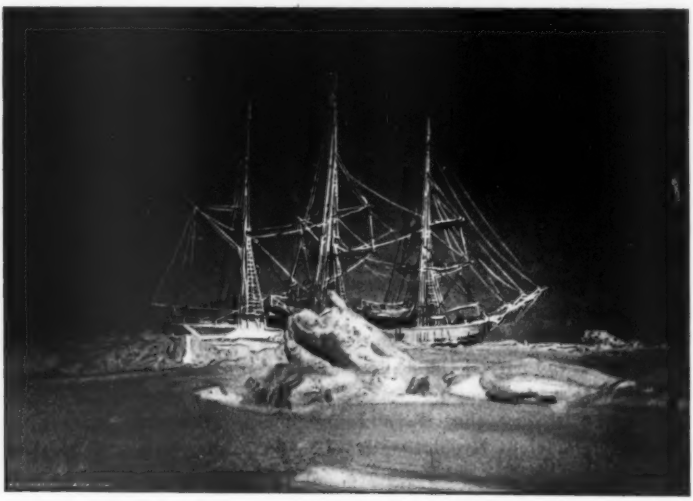


FIG. 9.—THE "BELGICA" DURING THE WINTER NIGHT.
(Photo by moonlight, Cook.)

100,000, or even a million; we amused ourselves like children in making and losing fortunes.

Personally, I retain many pleasant recollections of the polar night, for I made meteorological observations after all the others had gone to bed; and, in the profound silence that reigned on board, alone in my laboratory, I rejoiced in the solitude. Between the hourly observations I was able to read a great deal, and to profit by the perfect tranquillity, so difficult to obtain under ordinary conditions.

The sun reappeared on July 23. With its return our torpor disappeared, and gave place to general activity. Our usual work was resumed, and we were again able to venture on the ice. Lecointe, Cook, and Amundsen even risked a long expedition, taking with them provisions for fifteen days, a fur sleeping-bag for three, and a tent.

FIG. 10.—FORMATION OF "RASSOL FLOWERS" ON THE NEW ICE IN AN OPENING PRODUCED DURING THE DRIFT OF THE PACK.
(*Photo by Cook.*)

They stayed out for a week, but did not make much progress, for, after a strong breeze, several channels formed in the ice-field, and they had the greatest difficulty in regaining the ship in safety. We had no kayaks, and the practical result of this little expedition was to show that without them all attempts to traverse long distances on the pack must be futile. It was also made evident that it is impossible to go far from the floe on which an expedition is encamped without running grave risks of being unable to find a way back. For this reason I do not appreciate the opinion of a German critic, who has expressed surprise that we did not try to attain a high latitude on the pack, by following a direct route to the pole. The great problem is to find the position of the ship when it is time to return to it. If we had left the *Belgica* on August 10, in lat. 70° 50′ S., long. 86° 30′ W., we should have had to find her again, one month later, on September 10, in lat. 69° 50′ S., long. 82° 40′ W., and I greatly doubt if my German critic, even with the most favourable hypotheses, could have accomplished this *tour de force*.

With the return of the sun we made an effort to discontinue our *régime* of preserved food, and to live entirely on fresh "beef-steaks" of seal and penguin. It is extraordinary how the change pleased us. We ate nothing afterwards on the *Belgica* but the delicious "penguin beef-steak," which has not, it is true, much resemblance in flavour to the ordinary beef-steak, but is none the worse for that.

10. *The Icepack.*—The expeditions on the ice were not made exclusively

with the intention of filling our larder, for in most cases it was not necessary to go for hours along the edge of the waterways to get penguin and seals; as a rule, we got more than were needed. But the exercise did us a great deal of good, and we willingly undertook long excursions.

Whenever the weather was not foggy we could easily discern the aspects of the pack, and I gladly profited by some fine days to photograph the varied forms presented by the surface of the frozen sea. The rigid crust of the frozen ocean well deserves special study from a geographical standpoint. The numerous descriptions of the pack-ice of north polar regions, which have been left to us by the older voyagers, and especially those of Weyprecht, lead me to suppose that the antarctic ice differs from it in several respects. The characteristic feature of the southern pack is the thick layer of snow which lies on it all the year round. Except for the young ice, which forms in the open channels, is broken up by every movement caused by the wind, and often presents a bare glassy surface, the floes resemble an immense plain covered by a thick mantle of snow. The weight of this snow is so great that the ice is often depressed below the water-level, and the base of the snow is transformed into blue, granular, compact ice, very different in its physical properties (composition, structure, etc.) from the ordinary ice produced by the freezing of sea-water. The fallen snow is changed into *névé* under the influence of solar radiation and frequent changes of air temperature. Under the action of wind, freshly fallen snow is drifted

FIG. 11.—INFLECTIONS OF THE ICE PRODUCED BY PRESSURE; FORMATION OF ICE-HUMMOCKS.
(*Photo by Arctowski.*)

FIG. 12.—AN OLD PRESSURE-RIDGE IN THE PACK.
(*Photo by Cook.*)

over the ice-field like sand across a desert, and whenever an obstacle like a hummock is met with, small dunes, or ripple-marks, or long trails, clearly indicate the direction of the wind. The kumatology of snow was specially interesting in the region of "pressure hillocks," and I have taken many photographs illustrating the description which I shall give of these varied phenomena in a special memoir of the *Belgica* reports. I have spoken of regions of "pressure hillocks." I may explain that after the polar night and later, during the summer, the rigid surface of the Antarctic ocean became markedly different in appearance from when we first entered it. The small floes joined together, so that the independent units became larger and larger, till they were sometimes several miles in diameter. From the crow's nest of the *Belgica* we could see the whole of our floe, and the neighbouring floes pressing hard on it and on each other, all of them fringed with hummocks. These little elevations were regions of true folding and faulting, and of great interest on closer study. Miniature mountain chains, they had all the characters of the great ranges of the earth, for all the traits of a mountain range were present, except those due to running water and volcanic action; a "structural surface" altered only by a leveling agent *par excellence*, drifted snow. I will not commit myself to a maze of description; I only wish to point out one analogy. The distribution of gravity on the surface of the continents presents many strange anomalies. Amongst these, modern research seems to have disentangled one general principle—that the value of

gravity (reduced to sea-level) is less in a mountainous region than in contiguous plains. It seems as if there were empty spaces under the mountains, as if where the crust is crushed and squeezed so as to form ridges on the surface, the denser magma is found at a greater depth than elsewhere. This principle goes by the name of *Isostasy*. The isostasy of fold-ranges compels us to admit that the masses of the crust which have been compressed along a line, forming a chain of mountains on the surface, are equally depressed into the dense magma of the interior, so that a corresponding chain, composed of relatively light material, faces towards the Earth's centre. It seemed interesting to test this hypothesis for the miniature ice-ranges which were formed along a line perpendicular to the direction of pressure, and to ascertain the conditions of equilibrium of the hummocks. I therefore measured the thickness of the ice in different places, and made a series of borings (with a small geological boring tool) along a line perpendicular to the alignment of one of the hummocks. The result is important, for I found under the hummock a symmetrical protuberance much larger than that emerging above the surface of the sea. The hummock was therefore in perfect equilibrium, the ice accumulated below displacing a volume of water sufficient to keep the little range perfectly stable, and therefore to make it permanent. The greatest thickness I measured in this particular case was 9 metres (29·5 feet); but as this was in a hummock which raised itself scarcely 2 metres ($6\frac{1}{2}$ feet) above the sea surface, I am led to suppose that in the regions where the ice is greatly crushed and dislocated the maximum thickness may be 15 metres (49·2 feet), or even more. Such, however, must be regarded as exceptional cases, due to pressure. In normal circumstances the field-ice may be taken as about

FIG. 13.—ASPECT OF NEW HUMMOCK PRODUCED BY THE COMPRESSION OF TWO FLOES.
(*Photo by Arctowski.*)

2 metres ($6\frac{1}{2}$ feet), or, in the case of ice several years old, not more than 3 to 4 metres (10 to 13 feet) in thickness. The freezing action clearly tends to a limit which cannot be surpassed, however low the temperature. This is the invariable result of measurements in the arctic regions, and it is entirely supported by our measurements during our wintering in the antarctic.

11. *Summer in the Ice.*—The greatest cold we experienced occurred in September; on the 8th the thermometer sank to −43° C. (− 45·4° Fahr.), an extreme temperature when one considers that we were very far from land, and only in 71° S. lat. We took advantage of the sunshine when it came, following the example of the seals, who lay motion-

FIG. 14.—DRIFTED SNOW BURYING OLD HUMMOCKS.
(*Photo by Arctowski.*)

less on the ice for hours together enjoying sun-baths. When there was no wind we felt warm at a temperature of −15° C. (5° Fahr.), and even −25° C. (− 13° Fahr.), which is easy to understand, as evidently the temperature of the air did not indicate all the heat we felt, and we had only to go into the shadow to feel the difference.

In the antarctic there are strong equinoctial storms, which follow close upon one another. The storms which preceded the establishment of the summer *régime* were accompanied by tremendous snow-drifts, and as the *Belgica* presented an obstacle to these, large quantities of snow accumulated, and at length almost buried her. It became necessary to extricate her, and the work had to be done quickly, as she threatened to sink gradually, dragged down by the enclosing ice. But we succeeded in clearing all the snow and ice down to sea-level, and the ship raised herself out of the ice in which she had been nipped. Future expeditions may profit by our experience; at the beginning

of favourable weather the ice should be entirely cleared away from the ship, so as to leave her free to move if the pack opens.

12. *Leaving the Pack.*—Until December we had every confidence that the sun would melt the ice and break up the floes to such an extent that we could make our escape easily. But when December had passed, and the sun made his daily tour of the horizon without melting anything, we felt ourselves deceived. The lanes certainly opened more freely, and although the thermometer fell to −14° C. (6·8° Fahr.), the young ice ceased to form. Everything seemed to promise that the *Belgica* would soon be in an open channel, and making her way gradually to the edge of the pack. But our big floe would not give way; there we remained, at the mercy of fate, helpless in the middle of an ice-field several miles in circumference. We had to keep up our courage, although our provisions were coming to an end, and rather than face a second winter we should have to leave the ship. We would not have died of hunger, for penguins were plentiful, but we should have had to prepare seal-oil for lighting purposes, and as our coal would have run short, we would have had to depend on seal-fat for heating. In effect, we should have had to lead the life of Eskimo, and after the experience of one winter in the ice, we had enough of it. So we resolved to attack our floe with the explosives with which the expedition was provided. We carried a large supply of tonite, but experiments at low temperatures had previously shown us that the effect of this explosive on the ice was practically *nil*. Bombs laid on the surface produced no effect at all. We obtained better results afterwards with mines, laid in the ice, and these led us to make experiments on a larger scale. A hole was bored through the ice about 500 metres (1640 feet) ahead of the *Belgica*, and in this we placed a barrel of dynamite, about 3 metres (9·8 feet) below the surface. Several long fuses were lighted, and while they burned we removed ourselves as far away as possible, believing that the explosion was about to blow a good part of our floe into fragments. Nothing of the sort happened. The spectacle was imposing: a terrific report was heard, a sheaf of pulverized ice and water rose to a height of 50 metres (160 feet), but there was no fracture, not even a crack in the ice. We had to give up all idea of explosives.

After doing some work in a direction leading the shortest way out of the pack, we perceived that this route was hopeless, for we should have had to cut through three lines of hummocks, where the ice was very thick. But a closer examination of our floe fortunately revealed an old fracture, close astern of the ship, on which the ice was only from 1½ to 2 metres (4·9 to 6·6 feet) in thickness. Along this we cut a channel 700 metres (2297 feet) long, and wide enough to allow the passage of the ship. The task was long and arduous, but as it was a matter of life or death to us, and as it was equally urgent that the results of our scientific work should not be lost, it was no use hesitating, and the work went on cheerily, day and night, for a whole month. As we

had only three saws, we could not all work together, so we divided into two parties, one working by day, the other by night. We had no want of light, for the work was done during January and February.

The method ultimately employed was very simple. Starting from the edge of our floe (AC, Fig. 15), two lines AB and CD were cut; then EF, and the triangle AEF was detached and pushed out of the way. Next the line GH was cut, and the quadrilateral ECHG removed; then EK, and another polygon was free. Thus we got rid of the ice piece by piece, and as each slab had to be pushed out, the channel already cut was kept open.

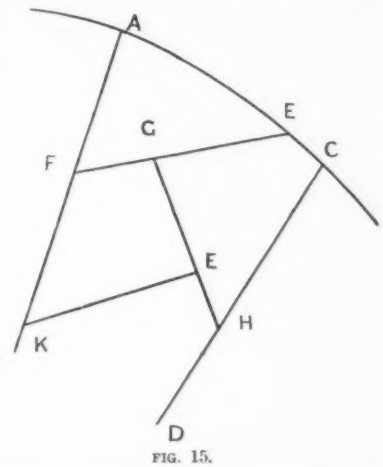


FIG. 15.

The work was almost completed when a storm came upon us. Strong pressure was brought to bear on the pack, and the unfinished part of our canal gave way. Then the *Belgica* was nipped between two large floes, and as the swell from the ocean reached us from outside, these crushed and left the vessel alternately with every wave. We had three days of anguish, three days in which we could not tell what a moment would bring forth, for the shocks followed one another without ceasing, and the *Belgica* might yield to the pressure at any moment. But it turned out otherwise. The sea went down, and after some more labour, aided by a free use of our tonite, the *Belgica* was finally delivered on February 14, 1899.

We made rapid progress through the ice, northwards this time, for a whole day; but then, on the edge of the pack, our way was completely barred by a number of small floes, packed close together. We were drifting rapidly to the west, and ahead of us innumerable icebergs were passing; it seemed as if the pack were surrounded by a belt of bergs, through which we must pass. It was only after a long month's waiting, tossed about all the time by the ocean swell, that we got a chance to escape to the open sea, towards which the water-sky to the northward had all the time been showing us the way.

The *Belgica* left the pack on March 14, and on the 28th we were back in Punta Arenas.

Conclusion.—I do not think this short account of our adventures should discourage future voyagers in the antarctic pack-ice, but rather the contrary. The *Belgica* Expedition has shown that a small vessel, provided with only a small auxiliary engine, can enter and remain

in the pack with every confidence; and further, that one can get out again and return home safe and sound. But the important fact established by this first wintering in the antarctic is that the new method of exploration, first tried by Nansen in the *Fram*, can afford excellent scientific results. The value of the results of the *Fram* Expedition has been indicated by the two volumes of the report already published, and I can affirm that the scientific results of the Belgian Antarctic Expedition, of which the report is in the press, will form a really valuable addition to our knowledge of the antarctic regions, notwithstanding the comparatively limited resources at the disposal of the commander and the scientific staff. Again, I repeat that the new method of exploration of polar regions is extremely fruitful, and that its application should be widely extended.

Before the reading of the paper, the PRESIDENT said: We welcome here this evening one of the principal members of the scientific staff of the Belgian Antarctic Expedition, which, as you will remember, wintered in the antarctic pack in the years 1898–99. We have every reason to admire the work that has been done by this scientific expedition under great difficulties. The funds which were collected for that expedition were very small, very small indeed. I remember going over the ship in August, 1896, with Captain Gerlache, and thinking how very small the accommodation would be for purposes of a polar voyage; but M. de Gerlache found numerous volunteers, men of distinction in science, to accompany him, and Mr. Arctowski, who was constant in his observations throughout the winter, and who also made a number of very valuable observations on the land that they discovered, is now with us this evening. I am sure we shall all be extremely interested in what he has to tell us, and in the views which he will be able to give us on the screen, and we shall give him a very warm welcome at the end of his address. I now call upon Mr. Arctowski to read his paper.

After the reading of the paper the following discussion took place:—

Dr. W. T. BLANFORD: I am sure that everybody will have listened with very great interest to the accounts Mr. Arctowski has given us of the antarctic regions. But whilst we have listened with very great pleasure to his description of adventures, the points in his accounts which will, I think, attract most attention relate to scientific observations. The additions to geographical knowledge appear at first not to be very great: an additional sound has been found, a number of small islands have been mapped and named, and there it may at first seem that the geographical part of the discovery terminates. I can only say that I think more important geographical observations have been made than those which are connected with the additions to our maps, valuable as these are, and although the subjects were necessarily, in the abridged account to which we have just listened, passed over very lightly, there are two points to which I should like to call attention. In the first place, Mr. Arctowski has made some most valuable observations on the older glacial action in the southern hemisphere, and the most important of these are perhaps at Terra del Fuego, where Mr. Arctowski has shown very clearly that the glacial conditions at no very distant geological date were greater than they are now. He has found moraines and other evidences of glaciers where no glaciers now exist; he has shown that exactly the same phenomena occur near Cape Horn which are so striking in parts of Europe. Now, I cannot say that no observations of ancient glacial evidence have been made in South America before, because I have heard of some; but they were rather opposed to Mr. Whymper's very important observations

in tropical South America. I ought to have premised by saying that Mr. Arctowski has not only shown in the case of Terra del Fuego that the glacial conditions were much greater at no distant period than they are now, but he has also shown the same in Graham Land. I am quite aware that the occurrence of a glacial period in Pleistocene times is disputed by a few—by Sir Henry Howorth, for instance—but I think the general opinion is that at no distant period the temperature was lower than it is at the present day, and that there existed great glaciers where there are none now. At first the difference was attributed to purely local conditions; it was supposed to be the result either of greater elevation or of a different distribution of land and water, and it was shown how if the land in North-Western Europe and in Canada were a little higher, and if the Gulf Stream, instead of flowing into the Atlantic, flowed somewhere else, a glacial epoch might be brought back to these islands, and that we might be enjoying masses of ice in very much the same form as they exist in Greenland. Then there was another theory—this was Dr. Croll's—which was that although glacial conditions prevailed over the whole of the northern hemisphere, or over a great part of the northern hemisphere, they coincided with a time of comparative warmth in the south, and it has even been suggested by some that the southern hemisphere is at present enjoying a glacial epoch from which we are free. The idea of local glaciers, although it is still strongly maintained, has received one or two very hard blows. In the first place, there were those wonderful discoveries in Central Africa that glaciers came down on Mount Kenya at no distant period much lower than they do now. That is one of the most important observations made. Long before that Sir J. Hooker had shown that glaciers in Sikkim that now come down to 15,000 feet above the sea came down to 7000 feet. Similar observations have been made in New Zealand. So far, then, as the evidence extends, there is much in favour of the view that the glacial epoch was universal, and the evidence does not show that the cold period alternated in the two hemispheres. Although it is not quite certain, I am strongly inclined to believe that the glacial epoch was a period of intense cold throughout the entire world.

Then there is another point on which Mr. Arctowski throws considerable light; at least his remarks are eminently suggestive. I do not quite understand whether Mr. Arctowski holds that the area round the Belgica strait is a sunken area; but I think I understand him to regard it as an area of depression.

Mr. Arctowski: Yes, geologically speaking.

Mr. Blanford: Certainly the whole of the features of the land are in favour of depression having taken place. It is extraordinary the way in which the extreme southern portion of South America ends off in deep channels between islands, and in scattered islands that stand away from the coast. I do not think there can be any reasonable doubt that depression must have taken place in the area round Cape Horn, and there is a very similar conformation in the northern portion of Graham Land. Now, Mr. Arctowski speculated on the question as to whether the Andes, after running through the whole of South America, are not continued in Graham Land. That is an important geographical suggestion; but that the area round the antarctic region is an area of depression is very strongly indicated by evidence tending to show the connection in former times between the antarctic area and the other lands in the southern hemisphere. I spoke of this some time ago when dealing with some of Mr. Bernacchi's observations, and I pointed out that there were some curious connections between the fauna of Australia and the fauna of America. Although I am afraid it is too late to enter upon what is a very curious point, I will simply say this, that there is an indication that in Upper Palæozoic times, when the coal flora extended over the northern hemisphere, a totally distinct flora flourished in the southern hemisphere. Now, the remarkable

point about that southern or *Glossopteris* flora is that it appeared in Australia, in India, in South Africa, and in South America. Of course, the connection between Australia and South Africa might have been by way of India; but it is impossible to account in that way for the presence of similar plants in South America. And another point is, that in all these countries this southern flora is preceded by evidence of a glacial epoch. Then this flora gradually came northward, and it appeared in Russia, and in Mesozoic times it appears to have covered the whole world. But taking all the evidence together, and the remarkable fact of the *Glossopteris* beds being underlain by strata containing boulders which indicate glacial conditions, it does appear a reasonable conclusion that this flora may have come from somewhere in the neighbourhood of the south pole, and its appearance simultaneously in the southern continents shows that they were all in connection with each other and with the antarctic area, which was probably a continent then. I merely take the two cases to which I have referred as showing the great amount of interest that attaches to the observations made by Mr. Arctowski.

Mr. GEORGE MURRAY: I extend the very heartiest congratulations to Mr. Arctowski for the very admirable scientific results that were brought back from his expedition. They were in inverse proportion to the equipment which he has described as being of the most modest character. I wonder more and more, as further facts, and deeper and more important facts, come out as to the performances of the *Belgica*, how they were ever accomplished. It can only have been by the most strenuous labour both by the officers of the ship and the scientific staff on board, and I think we cannot use words of too high a character in praise of their exertion. He laments at the beginning of the paper that he was unprovided with written instructions for the expedition. I know it is a subject which is a difficult one, but I have often thought that expeditions might be conducted quite safely, and even with a large degree of success, without instructions. A gentleman whose name has been bracketed with that of Sir Clements Markham gave me this advice not long ago: that it was a very excellent thing to be provided with instructions, and still more excellent if they were to be thrown over the side. I will leave that part of the subject alone, and go on to one of the points that have been raised. Mr. Arctowski's paper raised in my head the idea that there might be rehabilitated that view of the late Dr. Croll which fascinated us a quarter of a century ago. I am afraid Dr. Blanford has given it a death-blow, and we cannot fall back upon that easy explanation of glacial phenomena; but with regard to the second part of his remarks I really feel I must venture to differ from the conclusions he drew. I think that his conclusions drawn from the *Glossopteris* flora are perhaps rather large compared with the facts upon which they are based. I cannot venture to put this view forth as a geologist so much as a botanist. Knowing something of the flora of that particular stage of development of the vegetable kingdom throughout the whole world, I think we must be extremely cautious indeed of drawing special inferences from special occurrences in special places. I think, if this were done, I could bring forward a series of facts to justify another series of conclusions. I have no facts to place directly against Dr. Blanford's, but I have other facts pointing in another direction that wholly conflict with his arguments. I come to a subject—and I feel I am only plunging from one subject to another—to a question which exercises the mind of the President of the Society at this time more than any other, and that is the provision of a relief ship to the Antarctic Expedition. I believe it is the duty of this relief ship that it should go to the antarctic regions and discharge its primary duty to Captain Scott and his gallant crew, but that it should escape at once out of the ice, should circumnavigate the globe between 55° and 60°, and take a line of soundings round the world. I believe by doing that it would carry out a

great feat of scientific exploration, a greater feat than any direct assault upon the antarctic continent. I believe it would suggest more; it would give us a line from which to advance, and from which to interpret those advances which have been made in the past from the time of Biscoe to the time of Ross and others later, and I think that is the great service which I should strongly advise and recommend. There is one other little point. Reference was made by Mr. Arctowski to the services of Bellingshausen. I wish those services, his adventures, could be laid open; they have been hidden up in the Russian language. By the instrumentality of the President, and by his extraordinary knowledge of these early voyages, in the forthcoming manual we shall have placed before the world the adventures of the early navigators, which are almost entirely unknown to the people of this country. My attention was called by Sir Clements Markham to the adventures of Biscoe, which have been extracted and will appear in the Manual, and I will promise you this, that for a story of gallant adventure I do not think you will find in English literature its equal. He made two voyages; he underwent the most appalling hardships; he carried out most excellent explorations recorded upon our maps; and as I told you, it was so little known to us, that when I sent the proofs of this part of the voyage to Sir Joseph Hooker, whose knowledge of antarctic literature is almost unrivalled, he said the greatest part was new to him, the adventures were excellent and the scientific part was excellent, and altogether it was a most gallant performance. I am very glad that this Society should be not only the inaugurator of a new voyage, but that this should be the occasion of a rescue from the past of a story of one of the earliest British navigators in the antarctic seas, with his almost unparalleled success and experience in the antarctic regions.

Dr. Mill: I feel it is too late to offer any remarks on this interesting paper. One could say much, but I will say little, and only again congratulate Mr. Arctowski on the splendid scientific enthusiasm he has shown. For those labours were carried out without pay, without, I am afraid, very much encouragement at the time, and in the face of difficulties which he has only faintly indicated; and they were in many departments—not only in geology, but in meteorology, he has produced results of the greatest importance. He has added his name to those of his distinguished countrymen who figure so splendidly on the roll of scientific explorers in the southern hemisphere—I refer to the Polish travellers in Australia. I congratulate Mr. Arctowski with great heartiness both on the quality of the work he has done, and on the admirable way in which, in English learnt within the antarctic circle, he has given us his paper.

The President: It is almost too late to continue this discussion, unless any one wishes to ask Mr. Arctowski any question.

Admiral Markham: Mr. Arctowski has given so fully all the details of the expedition, and has given us such a graphic account of the way in which the members of it lived, that there is very little to ask; but I would like to know, with regard to the drift of the ice, whether it was occasioned by the prevalent winds, or whether it drifted backwards and forwards irrespective of the force of the wind; and also with regard to the thickness of the ice in which the *Belgica* wintered. The lecturer stated, I think, that the ice met with during the cruise was from 2½ metres to 3 metres (8·2 to 9·8 feet) in thickness; I should like to know if that was the general thickness of the ice in which the *Belgica* wintered during her drift in the pack.

Mr. Arctowski: In answer to that question, I must say we have not data enough to give the mean thickness of the ice. The mean thickness of our floe was about 2½ metres (8·2 feet); but in some places we measured ice of 9 metres (29·5 feet) in thickness. I think that in one year the thickness of the ice may increase to 2 metres (6·6 feet). With regard to the drift, I can only say that in our region,

where the *Belgica* wintered, the drift is an absolute function of the wind. Of course there are deviations in the course, deviations which are due to the lands situated certainly in the east, very probably in the south, but almost always when the wind came from the east we drifted to the west or south-west along the unknown shores. I should like to refer to Dr. Blanford's remarks *apropos* of the universality of the glacial epoch. I have already published a paper about the question of the climate of the glacial epoch, published in the review *Ciel et Terre* (March, 1901), and I had occasion to discuss the question with Prof. Penck, of Vienna, on the last meeting of the German *Naturforscherversammlung*. It is very probable, if not certain, that the glacial epoch in the southern hemisphere was contemporary with the last glacial epoch of the northern hemisphere. What belongs to the climate of the glacial epoch, the idea of a very moist climate, which was expressed by Lyell and many old geologists, must be put away, and we must take as the most probable, as the more universal, a cold climate. Some comparisons have obliged me to think that the mean temperature of the antarctic land and of the Terra del Fuego was from 8° to 10° Centigrade (14° to 18° Fahr.) lower, during the glacial epoch, than it is now.

The PRESIDENT: I am glad to be able to congratulate the Society on the publication of what Mr. George Murray has referred to—two of our most interesting manuscripts of the antarctic voyagers, Biscoe and Balleny. They were presented to us by Mr. Charles Enderby, the great promoter of antarctic voyages, and have remained in manuscript in our library for half a century. They certainly will be found by the Fellows of this Society, when the Antarctic Manual appears, to be very well worth reading, and to be extremely interesting as well as suggestive. I have heard also that Bellingshausen the Russian explorer's work which has remained in Russian, but which of course Mr. Arctowski is intimately acquainted with from his knowledge of the Russian language, will appear in German, I believe by next August, in which case the expedition will be able to receive a copy before it finally leaves for the south. We shall all have very great cause to thank Mr. George Murray for the most valuable volume which is about to appear. It now only remains to us to pass a very hearty vote of thanks to Mr. Arctowski for his most interesting paper, and also for the beautiful illustrations—especially that half-dozen or more phases of the floe-ice, which are extremely valuable as well as interesting. They show not only the similarities, but also the great differences between arctic and antarctic ice, principally, I suppose, caused by the fact that whereas in the arctic regions the floe is covered by large ponds of water 2 and 3 and sometimes 4 feet deep in the summer, this never happens in the antarctic regions, where there is no thaw. Consequently the snow appears to accumulate during the summer, and presses the ice downwards in a way which does not happen in the arctic regions. Probably, as it reaches the salt water, the snow becomes converted into blue ice, and so the thickness increases. At the same time, it does not appear that throughout the winter the ice from its first commencement as young ice is of greater thickness than in the arctic regions—from 7 to 8 feet. All these photographs are exceedingly valuable, and so are those of the glaciers and of the icebergs. I trust hereafter we may have a volume from Mr. Arctowski giving a complete journal of his work during the winter, and it will then be seen, as it will be also in the publication of his scientific work, what an enormous amount of industry and of strenuous exertion throughout the winter must have been devoted to these observations. I have already had the good fortune of seeing one of his volumes—that in which there is a record of every aurora that appeared throughout the winter, prepared with extreme care. Therefore science has much to thank Mr. Arctowski for. We have this evening to thank him for the most interesting time we have passed in looking at his illustrations and listening to his most instructive paper, and I am sure you will all wish unanimously to pass a vote of thanks to Mr. Arctowski.

WITH THE "DISCOVERY" TO MADEIRA.

By HUGH ROBERT MILL, D.Sc., LL.D.

THE voyage of the antarctic ship *Discovery* to Madeira was an extremely pleasant and propitious commencement of what we trust will be a prosperous and successful expedition.

She left Cowes at noon on Tuesday, August 6, and threading her way through the multitude of yachts at anchor in the roads, all flags flying at half-mast for the death of the Empress Frederick, she proceeded slowly down the Solent. At 3 p.m. the ship stopped opposite Little Yarmouth; the friends who had remained as long as possible were taken off by steam-launches, and, the partings over, the *Discovery* entered the Channel in the teeth of half a gale of wind. As she kept close along the shore, the last views of England were singularly attractive in the afternoon sunshine. The great model of the terrestrial globe carved in stone on the slope above Swanage showed up clearly as we passed, and final friendly wishes for a pleasant voyage were signalled from the Station on St. Alban's Head. Portland Bill was passed as it was growing dark, the light on Start Point was sighted at midnight, and in the morning there was an unbroken sea horizon. The contrary wind died away, and the pitching gave place to rolling; but though a swell was running into the Bay of Biscay, the motion of the *Discovery* proved to be remarkably easy, and no one suffered appreciably from sea-sickness.

Beyond meeting a boat fishing for bonito in the middle of the bay, passing a few vessels, disturbing some shoals of porpoises, and seeing many specimens of the stormy petrel, there were no external incidents to distract attention from the work on board. The sea changed gradually from the green of the Channel to the almost pure blue of the open ocean, the temperature of the surface water increased slightly, and the wind, swinging round into the north-east, made it possible to set full sail, and so ease the engines. What appeared to be the true trade wind was met off the Strait of Gibraltar, and freshened daily.

An immense amount of work in the way of settling down was got through in the first week. The executive officers had their hands full in overhauling and restowing the light gear carried on the boat deck, checking the lists of stores in the various holds, and arranging the duties of all members of the ship's company in case of fire or of suddenly leaving the ship. The scientific staff were no less busy in getting the laboratories into working order. Every particle of iron was hunted out in the non-magnetic area within 30 feet of that inmost shrine of science, the swinging table on which the magnetic instruments are to be placed. So keen was the hue and cry in pursuit of the forbidden metal, that one could almost excuse the visitors who a few days before

had inquired whether, to ensure a free field for magnetic research, the engines also had not been made of copper.

The microscopes were securely fixed to the tables in the botanical and zoological laboratories—one specially set apart for Captain Scott, whose interest in every branch of science pursued on board is of the most practical and personal kind. Tow-nets were arranged, through which sea-water is pumped continuously, and the collections of plankton, or small organisms drifting in the water, removed and examined microscopically at intervals.

In the physical laboratory, which lies outside the forbidden areas, the services of the carpenter had to be requisitioned to find secure lodgment for all the apparatus containing iron ejected from the biological laboratories. Fittings also had to be constructed for the various pieces of apparatus which are to be in daily use; standard solutions had to be made up from the chemicals which had been weighed out carefully on shore and brought on board in hermetically sealed tubes, the distilled water being supplied from the condensing plant in the engine-room. Lieut. E. H. Shackleton, having undertaken the determinations of density and chlorine in the sea-water, took a course of instruction in handling the various instruments and calculating the results, detailed tables having to be drawn up to facilitate the process. Mr. Ferrer got the apparatus designed by Prof. Letts for determining the amount of carbonic acid in the air into working order, and a definite routine for carrying on the chemical and physical work was established.

Lieut. Royds, who is in charge of the meteorological observations, found the best part of the ship in which to set up Dr. Black's marine rain-gauge and evaporimeter; and he also set the various recording instruments to work so as to compare their records. The difficulty of altering the clockwork of half a dozen delicate registering instruments daily in order to bring them to ship's time was so serious that it was arranged to keep them running to Greenwich time, but to make a mark on the time-scale daily at local noon so that the local time-scale also could be easily applied. The recording instruments worked excellently on board, and it was interesting to see how the irregular rise and fall of the barometer through a wide range characteristic of the British climate gave place to the regular diurnal wave of regular rise and fall as the ship came within the influence of the trade winds.

Experiments were made in flying the Hargrave box kites, which it is hoped will prove serviceable for obtaining meteorological readings from the upper air in the antarctic regions. The kites were found to rise easily and keep their position steadily, with very little strain on the line when the ship was under way. The instruments, however, were not attached in the preliminary experiments, and the difficulty of hauling in the kites without allowing them to touch the sea suggests the

necessity for enclosing the meteorograph in a water-tight case when used from the ship.

On August 14 the ship was stopped for sounding off Porto Santo, and a number of the deep-sea instruments were tested in 450 fathoms of water. No scientific observations were made, the trials being devoted to the necessary preliminaries, such as arranging the working of the various lines by the forward and after winches respectively. Soundings are made from the port and starboard bows, where small projecting platforms are provided for the sounding-machines. The result of the trials, which lasted for several hours, was to suggest various improvements in the arrangements.

At 2 a.m. on Thursday, August 15, the *Discovery* anchored off Funchal, in Madeira, and several of the officers and staff had their first experience of sledge-travelling in the smoothly gliding ox-carros or the somewhat alarming toboggan sledges which descend the steeper streets, propelled by the force of gravity at the rate of 20 miles an hour or even faster. The stay at the beautiful island was brief, and at 2 p.m. on Friday, August 16, the anchor was up, and, the fires not being lighted, the *Discovery* was towed out to sea by a little tug. Some miles off the shore waves were running high and foam-crested under the steady trade wind, but the sea-breeze set up by the steep sun-baked mountains caused an indraught that completely checked and turned the wind onshore all along the land. At 6.30 p.m., half an hour before sunset, the ship was cast off, 4 miles from shore, and commenced the voyage southward under sail "in the heel of the north-east trade." The last letters were passed on board the tug, and with three hearty cheers the ship's company took their farewell of the land for many a long day. The *Discovery* started under very moderate sail, but was making good way through the water, and from the report of the mail steamer from the Cape, which came in three days later, she must have met a gale on the second day out, which, being from a favourable quarter, should have enabled her to show her best pace under canvas.

The life on board the *Discovery* is particularly happy and harmonious. Captain Scott seems to have arrived at a happy compromise between the rigidity of naval discipline and the free-and-easy life of the yachtsman. Order and comfort rule in the wardroom and on the lower deck, every man intent on doing his own duty, but not hindering or ignoring the work of his neighbour. An arrangement was made by which each member of the wardroom mess presides at table for a week at a time, the order of succession being alphabetical. Each night after dinner the toast of "The King" is proposed in naval fashion, followed on Saturdays by "Absent Friends." Each morning at ten o'clock all hands are mustered for prayers, but there are no vexatious formalities in the working of the ship, the scientific aim of the expedition being kept in

view all through. The tinned provisions, so far as they had been tested, proved of admirable quality.

As regards speed, the average of the whole trip to Madeira, for the most part under sail and steam, came out at $6\frac{3}{4}$ knots an hour, but no favourable opportunity occurred of seeing what she could do under sail only. Letters to the *Discovery* at Melbourne should be posted in London on Friday, October 4, and to Lyttleton, N.Z., on Friday, November 1, although it is possible that the mail of the following week in each case may be in time.

SIR WILLIAM GARSTIN'S REPORT AS TO IRRIGATION PROJECTS ON THE UPPER NILE.*

By E. G. RAVENSTEIN.

It is hoped that the Asuan and Asiut dams will be in working order before the flood of 1902, but even then there will be a deficiency of at most 4000 million cubic meters if the utmost requirements of the whole of Egypt in summer are to be satisfied. If the requirements of Egypt alone were to be considered, it would not be necessary to go to the upper Nile, for a dam (similar to that under construction at Asuan) could be built somewhere in the second or third cataract, and would store sufficient water for the purpose. But any project of the kind entertained must take account of the requirements of the Sudan, where large areas are solely dependent upon the annual rainfall for the support of the population.

It was with a view to studying this question that Sir William Garstin, the eminent hydraulic engineer, and Under-Secretary of State for Public Works, paid three visits to the upper Nile, in 1899, 1900, and 1901, penetrating on the last occasion as far as Gondokoro. The information gathered during these journeys is embodied in a report which Sir William presented to the Egyptian Government in June last.

In March, 1899, the White Nile above the Abbe island (235 kilometers above Khartum) was bounded on both banks by belts of papyrus and ambach. The country in places was flooded for a distance of 2 or 3 kilometers, and the khors draining the plains were full of water and green reeds. Landing was quite impossible. But in 1900, and again in 1901, owing to the failure of the rains in the upper Nile regions during the preceding autumn, the general level of the river was from 1·5 to 2 meters lower than during the corresponding months of the preceding years, and large tracts of mud flats along the river-banks had been put under cultivation. The low water interfered with the navigation of the river, and these difficulties were aggravated by floating

* 'Egypt,' No. 2 (1901). Map, p. 464.

masses of papyrus and reeds released from the blocks of *sadd* (or *sudd*) in the Bahr el Gebel.

The Sobat was explored only for a distance of 50 kilometers. The river for this distance has a channel about 100 meters wide, between high banks, a great depth of water, and a rapid slope, and as a feeder of the Nile it ranks next to the Atbara and the Bahr el Azrak. From December to March its waters shrink to comparative insignificance, but in July and August they are in full flood, and discharge probably no less than 1650 cubic meters in the second. On April 5 the discharge of the Nile 4 kilometers above its junction with the Sobat was 294·221 cubic meters per second; April 6, 24 kilometers below that junction, was 381,020 cubic meters; consequently the increased discharge due to the Sobat seems to have been 86·779 cubic meters.

The Bahr el Zaraf leaves the Nile above the Ghaba Shambe, and rejoins it, after an estimated course of 898 kilometers, in 9° 23′ 17″, about 80 kilometers below the Mokren el Bahur.*

In 1899 the volume of this river was very considerable, and when in flood it must have stood quite 1 meter above its usual level. In the spring of 1900, and again in 1901, the discharge of the river had become almost insignificant. On March 25, 1900 (128 kilometers above the junction), the discharge was only 32·16 cubic meters per second; and on April 3, 1901 (19 kilometers above the junction), it was 33·149 cubic meters. Sir William thinks that this decrease of volume is due to the removal of the sadd blocks, which enabled the waters of the upper Bahr el Gebel to escape freely, instead of being forced to seek an outlet through the "loop" of the Bahr el Zaraf.

The Bahr el Ghazal and the rivers forming part of its system are described as sluggish streams, the discharge of which, even when in flood, is insignificant (April 3, 1901, 36 kilometers above the Mokren, only 26·739 cubic meters). Hence that system does not play a prominent part in the actual Nile flood. It acts, however, as a large reservoir, which slowly drains away as the level of Lake No falls, and is therefore a potent factor in keeping up the level of the Nile in the summer months.

The lower Bahr el Gebel is bounded by reed swamps of papyrus, Um suf (*Phragmites communis*) and tiger-grass, broken at intervals by shallow lagoons or "mayas." There are no solid banks, properly so-called, and a rise of half a meter (in 1901) would have flooded the country to an immense distance. Signs of human life are rare throughout this region, the air is hot, and steamy, and malarial. The water, however, teems with fish, but whilst crocodiles are to be seen constantly, the

* That is, the "Meeting of the Waters." Sir William suggests that the "Lake No" of many maps ought to be called Lake Nuer. The name seems to be quite unknown in the country. Lejean gives the name of Bahr el Ajob to the sheet of water at the mouth of the Bahr el Ghazal, which is commonly known as Lake No.

hippopotamus seems to shun the river. A few night herons are the only representatives of bird-life as high up as the Elyab Dok. Beyond that old station the general character of the landscape changes; and higher land and forest approach on the west. "Sadd," properly so-called, disappears, and the river has never been known to be "blocked" to the south of the Ghaba Shambe. The marshes to the south of Bor are formed of a deep layer of sand, covered with a thin surface of clay, and are, as a rule, well over the summer water-level. Their vegetation is dense, but it is chiefly grass. Along this upper part of the river we pass the Belgian station of Kiru, picturesquely situated, but extremely unhealthy, if it is true that last year eight Europeans and three hundred native soldiers died there of fever. Gondokoro, well known as one of Sir Samuel Baker's stations, has recently been occupied by troops from Uganda.

Sir William Garstin devotes considerable space to a consideration of the "sadd" blocks, which until quite recently prevented the river from being navigated. On December 16, 1899, Major Peake left Omdurman with five gunboats and eight hundred Dervish prisoners, guarded by a hundred Sudanese soldiers, with the object of removing these obstacles to navigation. By March 27, 1900, he had succeeded in removing fourteen blocks, measuring 8000 meters in length, and holding 11,850 cubic meters. Blocks Nos. 16 to 19 were removed in January of the present year by Lieut. Drury, and an attempt is to be made in October to remove the only remaining block (No. 15), which will prove a difficult task, as it has attained a total length of 36 kilometers. The usual method pursued in removing these obstructions is to cut the surface into rectangular blocks of suitable size, hauling them out by steamers, and then letting them float down the river.

"Sadd" is a compacted mass of papyrus, Um suf, and the earth adhering to the roots of these reeds. Smaller swimming plants are mingled with it, but play no important part in the formation of the obstacle, still less does the light and brittle "ambach," which, moreover, is found but sparingly along the Bahr el Gebel.*

The formation of "sadd" is occasioned firstly by the direction of the river with reference to the prevailing south-easterly winds. Secondly, by the presence of large lagoons, surrounded by a dense growth of papyrus and Um suf to the windward. With the advent of the rainy season in April, the gales then arising uproot large masses of these reeds and set them floating upon the lagoons, their roots weighted by the earth clinging to them, hanging downwards, and striking again if

* The "sadd" of the Bahr el Ghazal, on the other hand, is chiefly composed of smaller swimming plants, and is consequently lighter in texture and less formidable than the "sadd" in the main river. Um suf, "mother of wool," seems to be vaguely applied to several species of reeds, including *Vossia procera* and *Phragmites communis*.

drifted into shallow water. If the stormy weather continues, large areas of marsh-vegetation are thus set in motion, and drift about at the mercy of the winds. If the river has overflown its banks, some of this vegetation may be drifted into its channel, when it floats down with the current until arrested by a sharp bend or at some narrow, funnel-shaped part of the river. As a result the river is quickly blocked up; the masses floating down from above are sucked underneath, until one solid block of tangled vegetation (and its adherent earth) fills up nearly the whole of the river-bed, leaving a narrow passage beneath, through which the confined waters rush with increased velocity. As a consequence of this obstruction, the level of the river above rises, until the pent-up waters have succeeded in escaping through a new channel, or a strong wind or the great volume of descending waters has carried the obstacle away.

Our sketches, Nos. 1–3 (see map), are designed to illustrate the formation of block No. 10, and after what has been just stated hardly require an explanation. Already on April 4 the lagoon was covered by floating vegetation. On April 7 and 8 it rained heavily, and strong gales from the south-east set the floating vegetation in motion towards the river, and finally forced it into it, so that by April 9 a solid block, shown in sketch No. 1, already extended across the river, its length being 500 meters, its thickness 5 meters at the lower end and 2 meters at the upper. Meanwhile the water above the block rose steadily until the difference of its level at the upper and lower ends amounted to 0·6 meter. Fresh masses of "sadd" came floating down the river, and were sucked below the existing obstruction; at the same time great masses of Um suf began to move upon the river, and by evening of April 11 a second block was formed above the original one, and the shallow channel from the lake to the river had been entirely closed, as shown in sketch No. 2. In the end the river channel above the block increased to a width of 320 meters, and in the afternoon of April 12 the river escaped through a channel formed along the eastern side of the block. All this while Major Peake and his people had been hard at work in removing this formidable obstacle, and at last, at 11 a.m. on the 13th, the last mass gave way, and the whole river surface was covered with floating masses of vegetation revolving and floating with the current. But so favourable are the conditions for the formation of "sadd" in this locality, that the river was once more obstructed on May 27, and again on June 10 (when it took thirty-two days to break up the block), and altogether eleven times in the course of the year, and it is only since December, 1900, that this part of the river has been freely open to navigation.

The measured discharge of the Bahr el Gebel, just above Lado, on March 29, 1901, was 622·962 cubic meters per second; at a spot 144 kilometers above Lake No, on April 1, 1901, it was 262·187 cubic meters.

A few days afterwards, on April 5, at a short distance above the Sobat, the discharge of the White Nile amounted to 294·221 cubic meters. Deducting these 294·221 cubic meters from the 622·962 cubic meters at Lado, we find a startling waste of 328·741 cubic meters, mainly due to the wide swamps bounding the river. It should be stated that all the above measurements of discharge were taken during low Nile, and that the full-flood discharges are very much more considerable, being estimated for Lado at 2000 cubic meters a second.

In discussing irrigation projects, Sir William confines his attention to the basins of the Bahr el Gebel and the Bahr el Azrak. Mr. Willcocks, late Director of Reservoirs in Egypt, first suggested in 1893 the utilization of the equatorial lakes as grand reservoirs for regulating the floods of the Nile. The suggestion is a tempting one. The Victoria Nyanza covers an area of 70,000 square kilometers, and if its waters could be artificially raised by only 1 meter, this lake alone would yield 70,000 million cubic meters of water, an amount far beyond any possible requirements. Sir William, nevertheless, abandons the idea of utilizing this lake, because he fears that a considerable rise of its water-level would flood large and populous areas of country, and that there might be difficulties with the German owners of the southern half of the lake. We need hardly say that a rise of the lake-level to the extent of 1 or even of 2 meters above its present level would not have the consequences feared by Sir William. Lake Albert, however, appears to him to offer all he requires, its only drawback being the fear of seismic disturbances, which one day may become more severe and sustained than they are now. That lake has an area of 5000 square kilometers, and by building a regulation dam it could without serious difficulty be raised to the extent of 3 meters, and afford thus storage for 15,000 million cubic meters of water. Allowing 1 meter for evaporation, there would still remain 4000 million cubic meters to meet the utmost requirements of Egypt, and 6000 million cubic meters for the Sudan. The water would be stored up during the rainy season, and discharged into the river during the months of low supply. But if such a scheme is to be realized, it is indispensable to regulate the Bahr el Gebel. Even now the channel of that river cannot hold and bring down the water actually existing in the river when at its lowest, and it certainly could not carry an extra volume. In order to confine the flood water within one single channel, it will be necessary to embank the river for its whole length between Bor and Lake No, a distance of 624 kilometers. If five years were to be allowed for the completion of such a scheme, its execution would involve an expenditure of £3,700,000! This scheme will have to be carried out if the Albert Nyanza is to be utilized as a reservoir for increasing the Nile supply, but if it is decided merely to secure the use of the water at present wasted in the marshes, a less ambitious scheme would prove sufficient. In that case

Sir William suggests the dredging and embankment of the Bahr el Zaraf throughout, and its use as an additional channel for the summer supply. Sir William admits that this scheme would not be as satisfactory as the embanking of the Bahr el Gebel throughout the length of the marshes, but it would involve an expenditure of only £1,250,000.

A third scheme is, however, put forward, and this Sir William evidently thinks preferable to either of the others. He proposes to convert Lake Tsana into a reservoir, and thus store sufficient water for the needs both of Egypt and the Sudan, and at the same time improve the navigation of the Blue Nile during the summer months. He supposes Lake Tsana to have an area of 3300 square kilometers (according to Dr. Stecker's survey, the area is only 2980 square kilometers). A rise of the lake of 5 meters would thus yield 16,500 million cubic meters. Allowing 3300 million cubic meters to be lost by evaporation, there would remain 4000 million for Egypt, whilst the balance could be made use of in the Sudan. No objection could be raised against this scheme, notwithstanding the fact that Sir William seems to be but imperfectly acquainted with the geographical features of the region with which he deals, if Lake Tsana were in the possession either of Egypt or of England. But who dare answer for the political future of Abyssinia? The Emperor Menelek might grant permission for the desired works to be carried out, but who can say what might be done by his successors? The destruction of a dam at the outlet of Lake Tsana might involve Dar Sennar in a great disaster. It certainly seems to us that something ought to be done for the irrigation of the rich alluvial soil extending for 700 kilometres along the Blue Nile from Rosaires to Khartum, but might not this object be attained more readily by building a dam across the Blue Nile above Rosaires, within Egyptian territory, and by damming up some of the "khors" which find their way into that river from the Abyssinian highlands?

THE LAKE-LEVEL OF THE VICTORIA NYANZA.

By E. G. RAVENSTEIN.

The record of the lake-level of the Victoria Nyanza was begun in January, 1896, by direction of Sir Ernest J. L. Berkeley, Her Majesty's Commissioner. The execution of this inquiry was intrusted by him to Mr. R. J. D. Macallister. Gauges were erected at Ntebe (Port Alice), the lake port of the capital; at Lubwa's (now Fort Thruston), near the outlet of the Nile; and at Port Victoria, in Berkeley bay. Care was taken to secure solid foundations for these gauges, so as to prevent a subsequent settlement. It was deemed sufficient to observe the lake-level once daily. An arbitrary datum level had, as a matter of course,

to be adopted for each station, but all observations published in the Reports of the British Association have been reduced to the mean lake-level at each station for the year 1896 by deducting 15·5 inches from the recorded readings at Ntebe, 18·46 inches in the case of Fort Thruston, and 36·53 inches in that of Port Victoria. On October 1, 1898, Mr. C. W. Fowler, Superintendent of Marine, adjusted all observations to the readings taken at Port Victoria, and since that date 36·53 inches have been deducted for each of the three stations.

Owing to political troubles, no record was kept at either station during thirteen months, from the beginning of August, 1897, to the end of the same month, 1898; whilst from Fort Thruston there are no reports for an additional two months, namely, for November and December, 1899. At Port Victoria the observations were discontinued

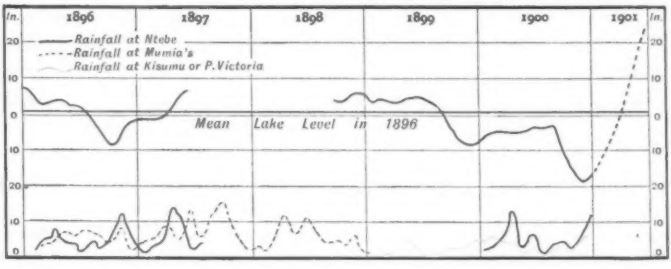


DIAGRAM ILLUSTRATING THE FLUCTUATIONS IN THE LEVEL OF THE VICTORIA NYANZA, AT NTEBE, IN 1896-1901 (UPPER CURVE), COMPARED WITH THE RAINFALL (LOWER CURVES).

at the end of July, 1899, but a new gauge was set up in September, 1899, at Kisumu, the Government post near Port Florence on Ugowe or Kavirondo bay. The records there were reduced to the extent of 30·3 inches to obtain an approximation of the lake-level as recorded.

The records for Ntebe, up to the close of the year 1900, embrace thus three full years and eleven months, those for Fort Thruston 45 months, for Port Victoria 30 months, and Kisumu 16 months.

The general results, as far as Ntebe is concerned, may be thus summarized:

	1896.	1899.	1900.
Mean lake-level ...	0·0	− 0·51 in.	− 8·13 in.
Highest level ...	Jan. 1 + 8·5 in.	June 8 + 6·47 in.	July 21 − 2·03 in.
Lowest level ...	Oct. 10 − 10·0 in.	Nov. 28 − 10·03 in.	Nov. 21 − 19·53 in.
Range	18·5 in.	16·50 in.	17·50 in.

The lake-level, to judge from the incomplete returns available, fell in the course of 1897, rose again slightly in 1898, only to fall again in

1899, and still more in 1900, when it reached its lowest level apparently for many years past. In 1901, however, an almost startling recovery took place, and by June 1 of the present year its level had risen 24 inches above the mean level of 1896.* The extreme range since the beginning of 1896 has thus been 43·53 inches, but if there is any truth in what the Roman Catholic missionaries in Buganda told Mr. Macallister (see 'Egypt,' No. 2 (1901), p. 49), that the mean level of the lake twenty years ago (*i.e.* in 1881) exceeded that of the year 1898 to the extent of 8 feet, the extreme range, as far as our experience goes, may be assumed to amount to at least 10 feet. Under these circumstances, a permanent raising of the lake-level to that extent, by constructing a

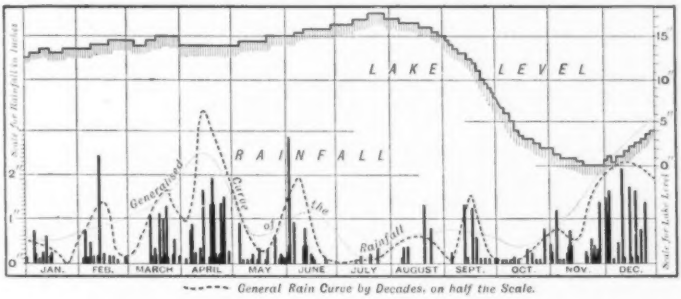


DIAGRAM ILLUSTRATING THE FLUCTUATIONS IN THE LEVEL OF THE VICTORIA NYANZA, AT NTEBE, IN 1900, COMPARED WITH THE RAINFALL.

regulating dam at Fort Thruston, is not likely to be attended by the disastrous consequences which seem to be dreaded by Sir W. Garstin.

The normal rise and fall of the lake-level is primarily governed by the rainfall throughout its catchment basin, and to a minor extent by differences in the amount of evaporation. A permanent fall of its level might even result from a natural deepening of the channel of the Nile where it leaves the lake. Of such a deepening, however, there is at present no evidence.

As to the rainfall, our information is still of a very fragmentary nature. We know, however, that the amount of rain varies not only with the succeeding seasons, but also locally. At Mengo, the capital of Buganda, 55 inches of rain fell in 1881, and only 35 inches in 1893. In the year 1894–5 90 inches were registered at the Bukoba station on the western shore of the lake, as compared with 49 inches on the southern extremity of the lake at Muanza. In 1897–8 73 inches fell at Bukoba, and 92 inches at Mumia's, in Kavirondo, towards the

* Sir William Garstin accounts for this sudden rise by supposing the sadd in the Kagira river to have been set free, thus producing a flood.

north-east. In the hills to the east of Mumia's the rain is known to be still heavier. In 1896–7 63 inches fell at Ntebe, 73 inches at Mumia's; in 1900 61 inches at Ntebe, and 49 at Kisumu. Many facts tend to prove that it is not local rains which appreciably affect what may be called the mean daily level of the lake, but precipitation throughout its vast drainage area.

A rainfall of 2·36 inches on November 14, 1896, only caused a rise of the lake to the extent of 0·75 inch, whilst the heavy rains during October and November (16·64 inches) only affected the lake to the extent of 5 inches. At Ntebe, between March 20–24, 1900, 3·7 inches of rain fell, and in the course of April 1 13·54 inches, yet the level of the lake remained unaffected, the heavy local rains being balanced by the outflow and loss by evaporation, or neutralized owing to a deficiency of rainfall elsewhere. On the other hand, in the course of May the lake rose slowly, but steadily, although very little rain was registered locally.* More remarkable still, on September 12 1·25 inches of rain fell, yet the lake-level actually fell half an inch.

Among the causes which exercise an incidental influence upon the lake-level the winds are probably the most powerful. There are regular land and lake breezes, and Mr. Macallister remarks that a strong south-west breeze will cause a rise in the level of the lake to an extent of from 1 to 3 inches; and at Fort Thruston, on November 13, a severe storm actually caused the lake to rise 3 inches. In order to ascertain the effect of the winds, it would be necessary to make at least three observations daily, or to set up a self-registering gauge.

Further fluctuations of the lake-level are undoubtedly due to differences of barometric pressure over parts of its surface, and there may be *seiches*, and perhaps even tidal movements. A successful study of these phenomena would necessitate the establishment of at least four gauges on the lake-shore (in the north, south, east, and west). These stations should be provided with self-registering apparatus, their altitudes should be determined by careful levelling, and the observations should, as a matter of course, embrace all the usual atmospheric phenomena.

The diagrams accompanying this notice explain themselves. For further information the reader is referred to the Reports of a committee of the British Association on the Climatology of Africa, of which the writer of this notice is chairman.

* At Fort Thruston between May 12 and 13 the lake rose four inches, although no rain fell.

ON RESEARCH IN GEOGRAPHICAL SCIENCE.*

By HUGH ROBERT MILL, D.Sc., LL.D., F.R.S.E.

Introductory.

The annual reassembling of friends and fellow-workers in the old re-visited towns, and the annual accession of new lovers of science, furnish a unique opportunity for a survey of the advances made in each department, a fitting occasion also for remembering those who have finished their work and can aid our deliberations only by the memory of their example.

Apart from our more intimate losses in the death of many distinguished geographers and devoted workers, the period since our last meeting has been for all a year of mourning. The passing of the nineteenth century was almost like the death of a friend, and it is still difficult to realize that the century which we had been so long in the habit of associating with everything new and great and progressive has itself become part of the past. Few coincidences have been more striking than the almost simultaneous close of that unparalleled reign which gave a name to the era including all that was best and most characteristic of the century. The death of Queen Victoria carried so keen a sense of personal loss into every heart that few attempts have been made to show how vast a portion of the stream of time—measured by progress—intervened between the terminal dates of her life. Think for a moment of the splendid advances in the one small department of geographical exploration during the late Queen's reign, the multitude of landmarks which have been crowned by the great name of Victoria—of the Earth's most southerly land and its most northerly sea, of the largest lake and most majestic waterfall of Africa, the loftiest lake of Asia, the highest peak in New Guinea, the widest desert and most populous colony in Australia, and of the two thriving seaports on either side of the North Pacific which couple together the British Dominions of western America and eastern Asia.

What could be more appropriate in this first meeting after the close of such a century and of such a reign than to pass in brief but appreciative review the advances of geography during those hundred or those sixty-five years? One thing, in my opinion, is more appropriate than to dwell on past triumphs or to regret past greatness, and that is to survey our present position and look ahead. In the first year of a new century and of a new reign we are reminded that we have a future to face and that the world is before us, and I propose to seize this opportunity in order to speak of the science of geography as it is now understood, and especially to urge the importance of the more systematic pursuit of geographical research henceforward.

Geography in the Universities.

The prospect of immediate expansion in many British universities seems at last likely to afford more than one opportunity of wiping out the old disgrace of the neglect of geographical science in the accredited seats of learning. Already Oxford has a well-manned School of Geography, and Cambridge has a Reader in Geography. The reconstituted University of London occupies the best position in the world for creating a chair of geographical research, situated as it is in the very centre of the comings and goings of all mankind, and in touch with the most

---

* Presidential Address to the Geographical Section, British Association, Glasgow, 1901.

complete geographical library and map-collection in existence. The new University of Birmingham may, it is hoped, prove better than its promises, and may perhaps after all provide some more adequate treatment of geography than its proposed partition amongst the professors of half a dozen special subjects, all of them concerned in geography, it is true, but none of them individually, nor all of them collectively, capable of embodying that co-ordination of parts into a harmonious unity which gives to geography its power as a mental discipline and its value for practical application. But England, in all that pertains to higher education, is still a poor country, and the will to do well is hampered by the grinning demon of poverty. Here, on the other side of the border, we are in a different atmosphere. The wave of the magician's wand in the hands of Andrew Carnegie has brought wealth that last year would have been deemed fabulous to the ancient universities in Scotland, and it will be a disgrace to our country if this splendid generosity does not result in the establishment of one or more fully endowed and completely equipped chairs of geography.

There may still be some people who view geography as the concern only of soldiers and sailors, adventurous travellers, and perhaps of elementary teachers. Exploration is undoubtedly the first duty of geographers, but it is a duty which has been well done, the nineteenth century having left us only one problem of the first magnitude. This is the exploration of the polar regions, and even here the twentieth century clamours for new methods.

The Antarctic Expeditions.

This year has seen the long-hoped-for Antarctic Expeditions set out on their great quest, a quest not only of new lands in the southern ice-world, but of scientific information regarding all the conditions of that vast unknown region. Two expeditions have been planned in Great Britain and Germany with a complete interchange of information regarding equipment and methods of work. Provision has been made for simultaneous magnetic and meteorological observations, and, in some instances, for the use of instruments of identical construction, and all possibility of any unseemly rivalry in striving for the childish distinction of getting farthest south has been obviated by the friendly understanding that the British ship shall explore the already fairly known Ross quadrant, where it is pretty sure that extensive and accessible land will favour exploration by sledges, while the Germans have chosen the entirely unknown area of the Enderby quadrant which no ice-protected steamer has yet attempted to penetrate, and where they enter a region of potential discovery before they cross the antarctic circle.

The British expedition is equipped on the good old plan that produced such fine results in the days of Cook and Ross; it is manned by sailors of the Royal Navy, and is under the command of a gallant naval officer, though, unlike the earlier vessels, the *Discovery* is not herself a naval ship. As in the days of Cook, the naval officers are assisted in their non-professional work by several young and promising scientific men, two of whom have already had experience of work in the polar regions. These have the great advantage of the counsel and help of Mr. George Murray of the British Museum, who goes as far as Melbourne in the position of Director of the Scientific Staff.

No one who has seen the zeal and unflagging enthusiasm with which Sir Clements Markham has organized the expedition can hesitate to accord to him in fullest measure the credit for its successful inauguration. And no one who has seen the quiet and good-humoured determination of the commander, Commander R. F. Scott, in overcoming many irritating preliminary difficulties, can doubt his fitness to undertake the heavy responsibilities of the voyage. I am sure that he

will be a worthy successor to Cook, Ross, Franklin, Nares, and all the other officers who have made their names and the name of the British Navy famous in polar service. The second in command, Lieut. Armitage, R.N.R., has had several years of arctic experience, and amongst the crew there are some old whalers whose knowledge of the ways of sea-ice should prove of value. The ship and her equipment are unique; it is no exaggeration to say that she is the best-found and most comfortable vessel which has ever left our shores on a voyage of discovery.

The German expedition has been more boldly planned than ours. It is new and experimental all through, as befits a young nation in its first exuberant efforts in a new field. If some people suppose that it may have made mistakes that our expedition has avoided, these at least are new mistakes from which new lessons are to be learned. If risks must be run—and we of the twentieth century are, I trust, no more timid of incurring risks than our predecessors of the nineteenth, or the eighteenth, or even the seventeenth—it is good that they should be new risks. To scientific men in Germany it appears natural and reasonable that a man of science should be the head of a scientific expedition; and that a geographer should lead a geographical expedition. Many British men of science sympathize in this view. Dr. Erich von Drygalski, one of the professors of Geography in the University of Berlin, has been entrusted with the command, to which he was appointed before the ship was designed, and for five years he has given all his time and thought to the expedition. He is supported by a band of highly trained specialists, who have spared neither time nor travel in mastering the subjects with which they may deal, and each has also received a general training in the subjects of all his colleagues—an admirable precaution. The captain of the *Gauss*, who belongs to the Merchant Service, has taken a course of training from the Norwegian whalers off Spitsbergen. He will, of course, be absolute master of the ship and crew in all that concerns order and safety, but he will be under the direction of the leader in all that concerns the plan of the voyage and the execution of scientific work. This arrangement is one which has always seemed to me to be desirable, that the captain of a ship on scientific service should occupy a position in relation to the scientific chief similar to that of the captain of a yacht in relation to the owner; but it is subject to the drawback that a naval officer could not well be asked to accept such a divided command.

Whatever our views as to ideal organization may be, we are all certain that both expeditions will do the utmost that they can to justify the confidence that is placed in them, and to bring honour to their flags. We know that the officers and staff of the *Discovery* belong to a race which, whether trained in the University or in the Navy, has acquired the habit of bringing back splendid results from any quest that is undertaken.

A Definition of Geography.

The bright prospects of Antarctic Exploration must not, however, blind us to the fact that exploration is not geography, nor is the reading or even the writing of text-books, nor is the making of maps, despite the recognition of leading cartographers as "Geographers to the King." These are amongst the departments of geography, but the whole is greater than its parts.

The view of the scope and content of geography which I have arrived at as the result of much work and some little reading during twenty years is substantially that held by most modern geographers. But it is right to point out that the mode of expressing it may not be accepted without amendment by any of the recognized leaders of the science, and for my own part I believe that discussion rather than acceptance is the best fate that can befall any attempt at stating scientific truth.

Put in the fewest words, my opinion is that—

Geography is the science which deals with the forms of relief of the Earth's crust, and with the influence which these forms exercise on the distribution of all other phenomena.

This definition looks to the form and composition of the Earth's crust itself, and to the successive coverings, partial and complete, in which the stony globe is wrapped. We sometimes hear of the "New Geography," but I think it is more profitable to consider the present position of Geography as the outcome of the thought and labours of an unbroken chain of workers, continuously modified by the growth of knowledge, yet old in aim, old even in the expression of many of the ideas that we are apt to consider the most modern.

Some Historical Landmarks.

Claudius Ptolemæus, about 150 A.D., gathered into his great 'Geography' the whole outcome of the Greek study of the habitable world. He laid stress on the threefold nature of descriptions of the Earth's surface, the general sketch of the great features of the world alone receiving the name of Geography, the more special description of an area he termed Chorography, and the detailed account of a particular place Topography.

Aristotle, who first adduced real proofs of the sphericity of the Earth, had not failed to note the relationships which exist between plants and animals, and the places in which they are found, and he argued that the character of peoples was influenced by the land in which they lived; but Ptolemy cared little for theories, comparisons, or relationships, confining himself rather to the record of actual facts. He made errors, the results of which were more important, as it happened, in advancing knowledge than were the truths which he recorded; for after the troubled mediæval sleep, when even the spherical form of the Earth was blotted out of the knowledge of Christendom, the scientific deductions made by Toscanelli from the false premises of Ptolemy heartened Columbus for his westward voyage to the Indies, on the very outset of which he stumbled all unknowing on the New World. When Magellan succeeded in the enterprise which Columbus had commenced, the fourteen centuries' reign of Ptolemy in geography came to an end; his work was done.

The rapid unveiling of the Earth in the sixteenth and seventeenth centuries cast a glamour over feats of exploration which has not yet been wholly dissipated, and it may not be easy, even now, to obtain wide credence for the fact that the explorer is usually but the collector of raw material for the geographer.

It is of vital interest to trace the re-formation of the theory of geography after its interruption in the Middle Ages. The fragments of the old Greek lore were cemented together by new and plastic thoughts, crudely enough by Apian, Gemma Frisius, and Sebastian Munster in the sixteenth century, but with increasing strength and completeness by Cluverius, Carpenter, and Varenius in the seventeenth.

The First Oxford Geographer.

The names of Cluverius and Varenius are familiar to every historian of geography, but that of Carpenter, I am afraid, is now brought to the notice of many geographical students for the first time. He was not so great as Varenius, but he was the first British geographer to write on theoretical geography as distinguished from mathematical treatises on navigation or the repetition of narratives of travel, and I think that there is evidence to show that his work had an influence on his great Dutch contemporary.

Nathanael Carpenter, Fellow of Exeter College, Oxford, published his book in 1625 under the title—

'Geographie delineated forth in two Bookes. Containing the Sphericall and Topicall parts thereof,' and with the motto from Ecclesiastes on its title-page—

"One generation commeth, and another goeth, but the Earth remayneth for ever."

The great merits of Carpenter's treatise are his firm grasp of the relation of one part of geography to another, his skilful blending of the solid part of the work of Aristotle and Ptolemy with that of the explorers and investigators of his own generation, and the wholesome common sense that dominates his reasoning. His definition is comprehensive and precise.

"Geographie is a science which teacheth the description of the whole Earth. The Nature of *Geographie* is well expressed in the name: For *Geographie* resolved according to the *Greeke* Etymologie signifieth as much as a description of the Earth; so that it differs from *Cosmographie*, as a part from the whole. Forasmuch as *Cosmographie* according to the name is a description of the whole world, comprehending under it as well *Geographie* as *Astronomie*. Howbeit, I confesse, that amongst the ancient Writers, *Cosmographie* has been taken for one and the self-same science with *Geographie* as may appeare by sundry treatises meerely Geographicall, yet intituled by the name of *Cosmographie*."

The differences held by Ptolemy to distinguish geography from chorography Carpenter shows to be merely accidental, not essential, and as to geography he says, "It is properly tearmed a *Science*, because it proposeth to it selfe no other end but knowledge; whereas those faculties are commonly tearmed *Arts*, which are not contented with a bare knowledge or speculation, but are directed to some farther work or action. But here a doubt seems to arise, whether this *Science* be to be esteemed *Physicall* or *Mathematicall?* Wee answer, that in a Science two things are to be considered: first, the *matter* or object whereabout it is conversant; secondly, the *manner* of handling and explication: For the former no doubt can bee made but that the object in *Geographie* is for the most part *Physicall* consisting of the parts whereof the Spheare is composed; but for the manner of Explication it is not *pure* but *mixt*; as in the former part *Mathematicall*, in the second rather *Historicall*; whence the whole Science may be alike tearmed both *Mathematicall & Historicall*; not in respect of the *subject* which we have said to be *Physicall* but in the manner of *Explication*."

Although somewhat diffuse in expression, the meaning of these statements is clear and sound, and to the British public as new now as it was in the days of King Charles. The book treats of mathematical geography and cartography, of magnetism, climates, the nature of places, of hydrography including the sea, rivers, lakes and fountains, of mountains, valleys and woods, of islands and continents, and at considerable length of people and the way in which they are influenced by the land in which they live. Whether Dr. Carpenter lectured on geography in Oxford I do not know, but his book must have acquired a certain currency, for a second edition appeared in 1635, and it seems probable that it was known to Varenius.

Varenius and Newton.

Varenius, a young man who died at twenty-eight, produced in Latin a single small volume published in 1650, which is a model of conciseness of expression and logical arrangement well worthy even now of literal translation into English. So highly was it thought of at the time that Sir Isaac Newton brought out an annotated Latin edition at Cambridge in 1672.* The opening definition as rendered in

* Dugdale, in the introduction to the English translation published in 1733, states explicitly that Newton produced his version for the benefit of the students attending

the English translation of 1733 (a work spoilt in most places by a parasitic growth of notes and interpolations) runs :—

"Geography is that part of *mixed mathematics* which explains the state of the Earth and of its parts, depending on quantity, viz. its figure, place, magnitude and motion with the celestial appearances, etc. By some it is taken in too limited a sense, for a bare description of the several countries; and by others too extensively, who along with such a description would have their political constitution."

Varenius produced a framework of Physical Geography capable of including new facts of discovery as they arose, and it is no wonder that his work, although but a part, ruled unchallenged as the standard text-book of pure geography for more than a century. He laid stress on the causes and effects of phenomena as well as the mere fact of their occurrence, and he clearly recognized the vast importance upon different distributions of the vertical relief of the land. He did not treat of human relations in geography, but, under protest, gave a scheme for discussing them as a concession to popular demands.

Kant.

As Isaac Newton, the mathematician, had turned his attention to geography at Cambridge in the earlier part of the eighteenth century, so Immanuel Kant, the philosopher, lectured on the same subject at Königsberg in the later part. The fame of Kant as a metaphysician has defrauded him of much of the honour that is his due as a man of science. As Prof. Hastie puts it: "His earlier scientific work, like an inner planet merged in light, was thus almost entirely lost sight of in the blaze of his later philosophical splendour."

Kant, it will be remembered, considered that the communication of experience from one person to another fell into two categories, the historical and the geographical: that is to say, descriptions in order of time or in order of space. The science of geography he considered to be fundamentally physical, but physical geography formed the introduction and key to all other possible geographies, of which he enumerated five: *mathematical*, concerned with the form, size, and movements of the Earth and its place in the solar system; *moral*, taking account of the customs and characters of mankind according to their physical surroundings; *political*, concerning the divisions of the land into the territories of organized governments; *mercantile*, or, as we now call it, commercial geography; and *theological*, which took account of the distribution of religions. It is not so much the cleavage of geography into five branches, all springing from physical geography like the fingers from a hand, which is worthy of remark, but rather the recognition of the interaction of the conditions of physical geography with all other geographical conditions. The scheme of geography thus acquired a unity and a flexibility which it had not previously attained, but Kant's views have never received wide recognition. If his geographical lectures have been translated, no English or French edition has come under my notice, and such currency as they obtained in Germany was checked by the more concrete and brilliant work of Humboldt, and the teleological system elaborated in overwhelming detail by Ritter.

The teleological views of Ritter were substantially those of Paley. The world, he found, fitted its inhabitants so well that it was obviously made for them down to the minutest detail. The theory was one peculiarly acceptable in the early decades of the nineteenth century, and it had the immensely important result of

---

his lectures "on the same subject" from the Lucasian chair; but we have been unable to find any more satisfactory evidence that Newton actually lectured on Geography at Cambridge.

leading men to view the Earth as a great unit, with all its parts co-ordinated to one end. It gave a philosophical, we may even say a theological, character to the study of geography.

Kant's views had pointed to such a unity, but from another side, that of evolution. It was not until after Charles Darwin had fully restored the doctrine of evolution to modern thought that it was forced upon thinking men that the fitness of the Earth to its inhabitants might result not from its being made for them, but from their having been shaped by it. It is certain that the influence of the terrestrial environment upon the life of a people has been carried too far by some writers—by Buckle, in his 'History of Civilization,' for example—but it is no less certain that this influence is a potent one.

The Nature of Geography.

Granted that such influence is exercised, some objectors may urge that geography has nothing to do with the matter, and we are compelled to acknowledge that the meaning and contents of geography are in this country as variously interpreted as the colour of the chameleon in the traveller's tale. Yet my thesis is that it is just this relation between the forms of the solid crust of the Earth and all the other phenomena of the surface that constitutes the very essence of geography.

It is a fact that many branches of the study of the Earth's surface which were included in the cosmography of the sixteenth century, the physiography of Linnæus, the physical geography of Humboldt, and perhaps even the *Erdkunde* of Ritter, have been elaborated by specialists into studies which, for their full comprehension, require the whole attention of the student. Geology, meteorology, oceanography, and anthropology, for example, have been successively specialized out of geography; but it does not follow that these specializations fully occupy the place of geography, for that place is to co-ordinate and correlate all the special facts concerned so that they may throw light on the plan and the processes of the Earth and its inhabitants. Geography is concerned with the results, not with the processes of the special sciences, and the limits between geography and geology, to take a single instance, are to be drawn, not between any one class of phenomena and another, but between one way and another of marshalling and utilizing the same facts. This was clear to Carpenter in 1625, though we have almost forgotten both it and him.

The Principles of Geography.

The principles of geography—the "pleasant principles," to use the phrase of old William Cuningham in 1559—on which its claims to status as a science rest, are generally agreed upon by modern geographers, though with such variations as arise from differences of standpoint and of mental process. The evolutionary idea is unifying geography as it has unified biology, and the whole complicated subject may be presented as the result of continuous progressive change brought about and guided by the influence of external conditions. These views have been often expressed in recent years, but they do not seem to have been very seriously considered, and no excuse need be offered for presenting them once more, though in an epitome curt to baldness.

The science of geography is of course based on the mathematical properties of a rotating sphere; but if we define geography as the exact and organized knowledge of the distribution of phenomena on the surface of the Earth, we see the force of Kant's classification, which subordinated mathematical to physical geography. The vertical relief of the Earth's crust shows us the grand and fundamental contrast

between the oceanic hollow and the continental ridges; and the hydrosphere is so guided by gravitation as to fill the hollow and rise upon the slopes of the ridges to a height depending on its volume, thus introducing the great superficial separation into land and sea. The movements of the water of the ocean are guided in every particular by the relief of the sea-bed and the configuration of the coast-lines. Even the distribution of the atmosphere over the Earth's surface is affected by the relief of the crust, the direction and force of the winds being largely dominated by the form of the land over which they blow. The different physical constitution of land, water, and air, especially the great difference between the specific heat and conductivity or diathermancy of the three, causes changes in the distribution of the sun's heat, and as a result the simple climatic zones and rhythmic seasons of the mathematical sphere are distorted out of all their primitive simplicity. The whole irregular distribution of rainfall and aridity, of permanent, seasonal, and variable winds, of sea-climate and land climate, is the resultant of the guiding action of land forms on the air and water currents, disturbed in this way from their primitive theoretical circulation. So far we see the surface forms of the Earth, themselves largely the result of the action of climatic forces, and constantly undergoing change in a definite direction, controlling the two great systems of fluid circulation. These in turn control the distribution of plants and animals, in conjunction with the direct action of surface relief, the natural regions and climatic belts dictating the distribution of living creatures. A more complicated state of things is found when the combined physical and biological environment is studied in its incidence on the distribution of the human race, the areas of human settlement, and the lines of human communications. The complication arises partly from the fact that each of the successive earlier environments acts both independently and collectively; but the difficulty is in greater degree due to the circumstance that man alone amongst animals is capable of reacting on his environment and deliberately modifying the conditions which control him.

It seems to me that the glory of geography as a science, the fascination of geography as a study, and the value of geography in practical affairs, are all due to the recognition of this unifying influence of surface relief in controlling, though in the higher developments rather by suggestion than dictation, the incidence of every mobile distribution on the Earth's surface.

The Classification of Geography.

Following out this idea, we are led to a classification of the field of geography in a natural order, in which every department arises out of the preceding with no absolute line of demarcation, and merges into the succeeding in the same way. This classification, it is necessary to note, is not like a series of pigeon-holes, which may be placed in any arbitrary order, but like a chain, in which the succession of the links is essential and unalterable.

Since form and dimension are the first and fundamental concepts in geography, the first and basal division is the *Mathematical*. Mathematical geography leaves the Earth as a spinning ball lighted and warmed according to a rigid succession of diurnal and annual changes. This merges into the domain of *Physical Geography*, which involves the results of contemporary change in the crust and the circulation of the fluid envelopes, with the resulting modifications in the simple and predictable mathematical distributions. This division falls naturally into three parts: Geomorphology, dealing with the forms of the solid crust and the changes they are undergoing at the present time; Oceanography, dealing with the great masses of water in the world; and Climatology, dealing with the effects of solar energy in the air. But all three spheres—lithosphere, hydrosphere, and atmosphere—are so

closely interrelated that no one of them can be studied without some preliminary knowledge of the others. This forms the largest and most important part of geography, more varied and intricate than the mathematical, better known and more definite than those involving life.

Bio-geography, the geographical distribution of life, arises directly from physical geography, which dominates it, but it is full of complex questions which involve the biological nature of the organism and the influence of physical environment, in which geographical elements, although predominant, do not act alone. Difficult as some of the problems of the distribution of life are at the present day, the remains of living creatures found fossil in the rocks, and the survivors of archaic forms still lingering in remote islands, supply us with our only instrument of research into the geography of past ages, often making it possible to lay down the areas of land and water in earlier geological periods.

The relation of man to the surface of the Earth detaches itself from the rest of Bio-geography by the number of exceptions to general laws of distribution and by the human power of modifying environment. It has necessarily been formed into a special department, *Anthropo-geography*. In primitive man the control exercised by environment is nearly as complete and simple as in the case of the lower animals; but with every advance in culture fresh complications are introduced. The relation of people to the land they inhabit, the choice of sites for dwellings and towns, the planning and carrying into effect of lines of communication, are all obviously much under the control of land form and climate. When people get settled in a favourable position they usually become attached to it; they acquire, one may say, the colour of the land, in modes of thought as well as in manner of life. The poems of Ossian and the Crofter Question require for their elucidation a knowledge of the geographical conditions of the Western Highlands, just as the Border ballads and the Border raids were largely conditioned by the geography of the Southern Uplands.

Attachment to the native valley or the native fields leads to the holding of land by clans or tribes and the fusion of tribes into nations, while changes in physical conditions stimulating migration from a deteriorating country may lead to the invasion of settled territories by homeless hordes. Here Anthropogeography buds off the subdivision of *Political Geography*, which takes account of the artificial boundaries separating or subdividing countries, and of the innumerable artificial restrictions and ameliorations which are superimposed on the natural barriers and channels of intercommunication. Even in political geography only a humble place is held by a statement of boundaries and capitals, to lists of which the great name of Geography has actually been confined by people who ought to have known better.

Anthropogeography views the world from the standpoint of the race, political geography from the standpoint of the nation; but room has to be found for a yet more restricted outlook, that of the individual, whose view of the world as it profits himself is known as commercial geography. This department deals with natural commodities and their interchange, and perhaps because here rather than in the other departments a successful comprehension of the inter-relation of cause and effect may be, in the language of the schoolroom, "reduced to pounds, shillings, and pence," the name of Applied Geography has been proposed. It fitly terminates our survey of the science, for the flickering disturbances of the equilibrium of supply and demand known simultaneously over the whole world, and the slower movements of transport to restore equilibrium, are still far from the power of scientific prevision, and all we can do at present is to point out certain clear lines of least resistance, or greatest advantage, due to the interactions of natural and human causes and effects.

To sum up in a sentence the field and the function of geography in the broad majesty of its completeness, we may say that it is the description of the surface of the solid Earth as it is in itself, as it acts upon the ocean, the air, and the living things which inhabit it, and as it is affected in turn by their actions.

Geography and the State.

Viewed thus I believe that geography will be found to afford an important clue to the solution of every problem affecting the mutual relations of land and people, enlightening the course of history, anticipating the trend of political movements, indicating the direction of sound industrial and commercial development.

It would be possible, unfortunately it would be easy, to enumerate misconceptions of history, blunders in boundary settlements, errors in foreign policy, useless and wasteful wars, mistakes in legislation, failures in commercial enterprise, lost opportunities in every sphere, which are due to the neglect of such a theoretical geography. Surely it is to the laws defining the interaction of Nature and Man that we should turn for guidance in such affairs, rather than to the dull old British doctrine of "muddling through." That vaunted process after all means that we are driven by stress of facts to do without intending it or knowing how, and at immense expense, the very things that intelligent study beforehand would have shown to be necessary, feasible, and cheap.

All this has been urged again and again, and it has fallen on the ears of those in authority "like a tale of little meaning though the words are strong." I admit that all advocates of a rational geography have not escaped the danger of the special pleader—they have promised too much. If a Government official were to say, "Yes, I confess there was a mistake here, the affair was managed badly, much money and some prestige were lost; it must all be done over again; please tell me how," I am afraid that the chances are that the answer would be vague, general, and unpractical. If the answer to this boldly hypothetical question is ever to be clear and definite, geography must be studied as it has never yet been studied in this country. It must pass beyond the stage of a recreation for retired officers, colonial officials, and persons of leisure, and become the object of intense whole-hearted and original study by men of no less ability who are willing to devote, not their leisure but their whole time to the work. The object of geographical research should be nothing less than the demonstration or refutation of what we claim to be the central principle of geography—that the forms of terrestrial relief control all mobile distributions.

A Projected Geographical Description.

In order to focus the question it may be convenient to consider the geography —or chorography, as Ptolemy would have termed it—of the British Islands. No author has ever attempted to give such a description. Camden's 'Britannia' was swamped by archæology; the county histories, which are certainly not deficient in number, were wrecked outward bound on the harbour-bar of genealogy. Sir John Sinclair's old 'New Statistical Account of Scotland' in the intelligent utilization of very incomplete data was a great but solitary stride in the right direction. Bartholomew's great 'Atlas of Scotland' supplies the cartographical basis for a modern description of the northern kingdom; but the description itself has not been undertaken on an equal scale. The work of producing a complete geographical description of the British Islands would be gigantic, but not hopelessly difficult.

The material has been collected at an enormous expenditure of public money, and is stacked more or less accessibly, much of it well-seasoned, some I fear spoilt

by keeping; but there it lies in overwhelming abundance, heaps of building materials, but requiring the labour of the builder before it can become a building.

There is first and chief the Ordnance Survey, one of the grandest pieces of work in mathematical geography that has ever been accomplished. The result is a series of maps almost as perfect as one can expect any human work to be, showing in a variety of scales from ½ of an inch to 25 inches to a mile every feature of the configuration of the land—except the lake-beds.

There is next the hydrographic survey by the Admiralty, giving every detail of the subaqueous configuration in and around our islands—except the lake-beds.

These two great surveys supply the basis for a complete description of the British Islands, and the geological survey, which in a sense is more elaborate than either of the others, completes the fundamental part. The geological map makes it possible to explain many of the forms of the land by referring to the structure of the rocks which compose them. Both the geological and hydrographic surveys are accompanied by memoirs describing the features and discussing the various questions arising from the character of each sheet; but there is nothing of the kind for the maps of the ordnance survey.

The ordnance maps show at the date of their preparation the extent and also the nature of the woodlands and moorlands, and this information is supplemented by the Returns of the Board of Agriculture, which each year contain the statistics of farm crops, waste land, and livestock for every county. These returns are excellently edited from the statistical point of view, but they are not discussed geographically. It is easy to see in any year how much wheat is raised in each county, but it is a slow and laborious process to discover from the Returns what are the chief wheat-growing areas of the country. The county is too large a unit for geographical study, as it usually includes many types of land form and of geological formation. Before the distribution of crops can be understood or compared with the features of the ground they must be broken up into parishes, or even smaller units, and the results placed on maps and generalized. The vast labour of collecting and printing the data is undertaken by Government, and paid for by the people without a murmur, but the geographer is left in ignorance for the want of a comparatively cheap and simple cartographic representation of the facts.

The Inspectors of Mines and the Board of Trade publish statistics of the industry and the commerce of the country, statistically excellent, no doubt, but in most cases lacking the cartographic expression which makes it possible to take in the general state of the country from year to year. The same is true of the Registrar-General's Returns of births, marriages, and deaths, in themselves an admirable epitome of the health conditions of the country, and of the fluctuations in population, but limited by a narrow specialism to the one purpose.

Finally and chiefly we have the Census Report. Once in ten years the people are numbered and described by sex, age, and occupation. The inhabited houses are numbered, and the smaller dwellings grouped according to size. The figures are most elaborately classified and discussed, so as to bring out the distribution of population, and its change from the previous decade. But to the geographer the Census Reports are like a cornfield to a seeker of bread. The grains must be gathered, prepared, and elaborated before the desired result is obtained. Nowhere is the cartographic method more useful than here. It is a striking contrast to turn to the splendid volumes of the United States Census Reports, many of them statistically inferior to ours, but thickly illustrated with maps, showing at a glance the distribution of every condition which is dealt with, and enabling one to

follow decade by decade the progressive development of the country, and to study for each census the relations between the various conditions.

These are only a few of the statistical publications, produced by Government, and embodying year after year a mass of conscientious labour, which, save for a few specialists who extract and utilize what concerns themselves, is annually "cast as rubbish to the void."

One small department, supported by public money, but under unofficial direction, may be referred to as an example of the successful employment of cartographic methods. This is the Meteorological Council, appointed by the Royal Society, and charged with the collection of meteorological data and the publication of weather reports, forecasts, and storm warnings. The maps, published twice daily to show the distribution of atmospheric pressure and temperature, are only rough sketches and very much generalized, yet they serve the purpose of presenting the facts in a graphic form, yielding at a glance information which could only be extracted from tables by long and laborious efforts. The pilot charts, published monthly by the same department, showing the average conditions of air and sea over the whole North Atlantic, and the occasional atlases of oceanographical data, are valuable geographical material.

The official work of Government is supplemented by the voluntary labours of many societies, in whose Transactions much valuable material is stored, and in not a few cases is well discussed. But even with these supplements gaps remain which must be filled by private enterprise before a complete geographical description can be compiled.

Considering the Ordnance Survey alone, it is hardly credible and not at all creditable that the Treasury should veto the extension of the survey to the lake-beds on the score of expense, yet such is the fact. The directors of the Survey have shown themselves ready to encourage private workers by placing the data presented by them upon the maps with due acknowledgment.

The Survey of the Lakes.

It is with profound satisfaction that I now make an announcement—by special favour, the first public announcement—of a scheme of geographical research on a national scale by private enterprise. Sir John Murray and Mr. Laurence Pullar have resolved to complete the bathymetrical survey of all the fresh-water lakes of the British Islands. Mr. Laurence Pullar will take an active part in the proposed Survey, and has made over to trustees a sum of money sufficient to enable the investigation to be commenced forthwith, and to be carried through in a comprehensive and thorough manner. It is intended to make the finished work an appropriate and worthy memorial of Mr. Pullar's son, the late Mr. Fred Pullar, who had entered enthusiastically upon the survey of the lochs of Scotland, and whose heroic death while endeavouring to save life in Airthrey loch last February must be present to the memory of many of you. Large sums of money devoted in good faith to scientific purposes do not always bring about the wished-for result; but in this case there is no room for anxiety on that score. Sir John Murray, with whom Mr. Fred Pullar had worked for several years, has generously promised to direct the whole scheme, and to be responsible for carrying it out. All the lakes of the British Islands will be sounded and mapped as a preliminary to the complete limnological investigation which is proposed. The nature of the deposits, the chemical composition of the water and its dissolved gases, the rainfall of the drainage areas, the volumes of the inflowing and outflowing streams, the fluctuations in the level of the surface, the seasonal changes of temperature, and the nature and distribution of aquatic plants and animals, will all receive attention. The geological

history of the lakes may also be inquired into with reference to such points as the growth of deltas, the erosion of the margins, and, perhaps, the conditions of the old dead lakes that are now level meadows.

Five years at least will be required to make these observations and to incorporate them in memoirs, each of which will be a complete natural history of the lakes of one river-basin. The proposed work wants more than money, direction, and time. It requires the services of several young and enthusiastic workers—preferably men who have completed their university course and are anxious to devote some time to research. Sir John Murray and Mr. Pullar wish to meet three or four capable young fellows, one preferably a chemist, one a geologist, one a botanist, and one a zoologist. When found they will be offered a salary sufficient to enable them to give their whole time to the work, but not large enough to induce any one who has not the love of science at heart to take it up. From my experience when working in somewhat similar conditions at the Scottish Marine Station seventeen years ago, I can promise those who will have the good fortune to be selected plenty of hard work, for which they will get the fullest credit—and this they will appreciate more keenly when they come to know the world better—and I can promise them also in their association with Sir John Murray a course of scientific and intellectual training such as even the universities do not afford.

Other Desirable Surveys.

The Geological Map requires to be supplemented by additional work on the nature of the superficial soil as it affects agriculture, such as is expressed in the *Cartes agronomiques* of France, going more fully into the chemical nature of the soil than is possible on the Drift Maps of the Survey which so usefully supplement the maps of solid geology. Such experiments as have been made at the College at Reading in collecting analyses of the soils in the neighbourhood might very well be carried out at the agricultural colleges and other centres all over the country.

Of equal value, though, perhaps, more obviously so to the scientific than to the "practical" man, is the study of the natural vegetation of the country. In a highly cultivated land like ours there are comparatively few places where the native flora remains in possession, but the mapping of the main crops which have supplanted it is nearly as useful. To become satisfactory from this point of view, the statistics of the Board of Agriculture ought to be supplemented by surveys made by trained botanists on the ground. A valuable beginning has been made under the ever-fertile stimulus of Prof. Patrick Geddes in the two sheets of a map of the plant-associations of Scotland, compiled by the late Robert Smith, whose premature death last year was a loss to science. It would be a splendid thing if this map could be finished as a memorial to the brilliant young botanist in the same way as the survey of the lakes is proposed as a memorial worthy of Fred Pullar, and I am glad to learn that there is some probability of it being carried on.

Of all the other distributions which might be worked out cartographically time fails us to speak; but reference must be made, however briefly, to a few.

Geography of the Air.

With regard to Meteorology, the distribution of temperature and pressure over the British Islands for the year and for the separate months have been worked out by the experienced hand of Dr. Buchan and published both in separate memoirs and in the 'Meteorological Atlas,' edited by Dr. Buchan and Dr. Herbertson. But such observations as the degree of cloud or of sunshine can, as yet, be treated only in a superficial and generalized way for want of data. Perhaps the most important

and certainly the most difficult of all the atmospheric conditions to discuss fully is precipitation. It depends on so many varying conditions, such as the form and exposure of the land, the altitude above sea-level, the direction and force of the wind, the relative frequency of thunderstorms, the distance from the sea, the direction of the average paths of cyclonic storms, etc., that far more numerous and more long-continued observations are required to establish the normal condition of the country than in the case of either temperature or pressure. When we reflect that the whole water-supply of the country depends directly on rainfall, and when we remember that the value of water-power made available by differences of level promises to be greater in the future than it has been in the past, we can see that a study of rainfall in conjunction with configuration may prove as valuable for the localization of the manufacturing centres of the future as the geological survey was for those of the present.

Thanks to the remarkable foresight and the untiring exertions of the late Mr. Symons, the volunteer rainfall observers of this country have been encouraged to organize their efforts, and by working on a common plan have accumulated within the last forty years a mass of observations unrivalled for number and completeness in any other land. But as yet the difficulties in the way of constructing a map of normal rainfall on an adequate scale have not been overcome, and much experimental work will probably be necessary before it can be accomplished. To this task it is my ambition to devote myself. I may be permitted to state that Scotland is far behind England or Wales in the number of rainfall stations per square mile. Thus there is, roughly, one rain-observing station for every 20 square miles of England, one for every 30 square miles of Wales, but only one for every 67 square miles of Scotland, and one for every 170 square miles of Ireland.

Rainfall observations only tell the amount of available water; the configuration of the stream-beds must be considered in determining water-power. The only country I know where the horse-power of the rivers has been measured and mapped is Finland; but, of course, individual rivers, such as the Mississippi, Rhine, Seine, and Thames, have been thoroughly studied. Before many decades have passed it will be a necessary element in the surveys of all countries, though at present the available data are few and scattered.

Population Maps.

In considering human geography we come to the most interesting and least occupied field of research. Until Mr. Bosse constructed his beautiful maps of the density of population of Scotland and England, we had absolutely no cartographical representation of the true distribution of people over the land. To map population by counties gives a very poor idea of the truth, for in such counties as Yorkshire or Perthshire there are large areas entirely without inhabitants, and small areas where the population is very dense. Mr. Bosse's maps were made on the principle of leaving blank all the land on which there were no dwelling-houses, and so obtaining a close approximation to the true density of population of the inhabited area. For Scotland his map shows at once that it is a function of configuration. It shows the densely peopled lowland plain, the less densely peopled coast-strip surrounding the country, and the least densely peopled valleys running inland into the great uninhabited areas. The population map of England, on the other hand, shows an absolutely startling relation to the geological structure, which in turn is closely related to the configuration. We are not astonished to see the centres of densest population coinciding with the Coal Measures, but it is both surprising and instructive to see how the density of population runs parallel to the strike of the Secondary and Tertiary rocks of south-eastern England, a

band of the lightest population following each outcrop of chalk and limestone, a band of dense population following each belt of sandstone or clay.

Anthropo-geography teems with fascinating subjects of research. The admirable investigations in the west of Ireland on the physical anthropology of the people might well be extended to the whole country outside the great towns, where all evidence of place of origin and original character is speedily lost. Good work has been done in this way by the Ethnographic Survey promoted by a committee of this Association, and a committee of the Royal Scottish Geographical Society has rendered great aid to the Ordnance Survey in the cognate study of the place-names of Scotland.

The distribution of religion, even in the three typical forms of Anglican, Presbyterian, and Roman Catholic—forms so typical as to be, broadly speaking, national—is most imperfectly known. The objection to a religious census is one which is somewhat difficult of comprehension in Scotland, and too polemic for sober discussion in England. But a few of the problems are worth being worked out by individuals. The curious islands of Roman Catholic continuity in Lancashire, the Hebrides, and the Highlands, can probably be related simply enough to the configuration of the country and the means of communication as influencing free movement of people at critical periods of history. There are many interesting points as to the geographical distribution of surnames, the relation of characteristic literature or poetry to specific areas; things small in themselves, but capable of very far-reaching influence if systematically worked out.

Geographical Synthesis.

Granted that the subsidiary surveys have been made and the results put in a strictly comparable form, the central problem remains—the synthesis of the complete geography of the country. This can perhaps be solved best by comparing the maps of the various distributions in the proper order, and seeing how far they are related to one another. For the general discussion the Ordnance Map on the scale of 1 inch to a mile should be used, and each natural region ought properly to be treated by itself, but as a matter of practical convenience it would probably be found best to select either the artificial boundaries of counties or the still more arbitrary lines bounding sheets of the map. Whatever small area is taken as the unit of description, it should be treated in such a way as to seek for and prove or disprove the existence of any control exercised by the form of the land and its geological character on the outcrops of the rocks, the nature of the soil, the course of the rivers, the temperature and movements of the air, the rainfall, the vegetation and agriculture, the distribution of population, the sites of towns, villages, and isolated dwellings, the roads, railways and harbours, the birth-rate and death-rate, and on the progressive changes in all these conditions which are shown in the discussion of the statistics collected annually or decennially. When such unit areas are worked out individually the results can easily be combined and condensed into a geographical description that will be complete, well balanced, and symmetrical. The work is practicable; it requires only time, money, direction and workers to carry it out; but although a specimen memoir, prepared by the authority of the Royal Geographical Society, met with a certain measure of approval, all attempts failed to obtain funds for making the work complete, and the scheme must await a more educated generation before it can be profitably revived in its entirety. Meanwhile this field for geographical study and research lies at the doors of every university where the subject is or may be recognized, and the labours of professors and students might be profitably directed to the completion of such memoirs for the surrounding district, gradually working further

and further afield. The idea is no more new than every other "thing under the sun." Such exercises, not so elaborately planned, but the same in essentials, were ordinary subjects for theses in the universities of Sweden and Finland during the eighteenth century. To come nearer home, the local handbooks prepared for successive meetings of the British Association are frequently very fair examples of the geographical description of a district. The essential qualities are rarer in guide-books; but we must not forget one brilliant exception, the poet Wordsworth's 'Guide to the English Lakes.'

It is pleasant to hear that through the encouragement of Sir John Murray the Scottish Natural History Society is taking up the systematic study of the basin of the Forth, and they will, I feel sure, give a good account of their labours. One point which must be very strongly emphasized is that a geographical treatise is distinguished from a jumble of facts mainly by the order and proportion in which the phenomena are dealt with, and by the relation of cause and effect that is established between them.

As to the utility of complete geographical descriptions, we must of course recognize their greater practical importance in new and developing countries than in old lands like our own. Yet even with us the study of the distribution of natural resources may suggest important changes, involving great redistributions of population.

A Geographical Warning.

Hitherto, except as regards exploration and cartography, the position of geography in this country has never been satisfactory. Times are changing, and even in exploration we are now only one amongst many rivals, often better equipped by education, usually in no way deficient in daring. Although the best work of several of our cartographers in Edinburgh and London need fear no comparison, we cannot conceal the fact that Germany leads the world in map-making. As regards the recognition or even the comprehension of geography by the State, by the universities, and by the public, we are equally far behind our neighbours across the North Sea.

It has sometimes been hinted that the study of geography has been deliberately discouraged by politicians or by merchants because too much knowledge on the part of the public might embarrass foreign policy or lead to mercantile competition; but we surely cannot entertain such unworthy suspicions. I am inclined to attribute the neglect of the subject merely to ignorance of its nature due to imperfect education.

Two cases in which the application of geography to political and practical affairs suggests a definite course of action may be mentioned as examples. There is still one important colonial boundary entirely undelimited in a region somewhat difficult of access and still little known, where goldfields will probably be found or reported before long, and where a very serious international question may suddenly arise in a part of the world absolutely unsuspected by most people, even amongst those who interest themselves in general politics and in colonial affairs. It would cost a comparative trifle to survey the region in question, and to lay down that boundary-line before the goldfields are touched, so that no international trouble could ever arise. What it may cost to postpone the matter until claims have been pegged out on debatable land, the British Guiana and Venezuela arbitration, the Alaska difficulty, and South Africa are there to tell us. It would be interesting to calculate, now that the cost of a week of fighting is known, the saving in pennies on the income tax that would have accrued from a survey of South Africa if that had been carried out as an imperial duty when Cape Colony was settled. I do not for a moment suggest that a survey would have prevented

the war; but it is not unreasonable to believe that it would have shortened it by some months. In this connection it is satisfactory to know that a valuable report has been drawn up by a committee of the British Association, presided over by Sir Thomas Holdich, embodying a scheme for the systematic survey of British protectorates.

The second example comes nearer home. The utilization of wind- and water-power must increase in importance as mineral fuel diminishes in amount or increases in price. Wind- and water-power will never fail as long as the sun shines and the land remains higher than the sea; but what may fail unless timely precautions are taken is the power of utilizing them for the benefit of the community at large. Are the existing laws as to water-rights and the absence of laws as to the utilization of wind desirable and satisfactory? The usual answer to such questions is, "Why trouble about that just now? these matters are not urgent, other things are." That argument is answerable for many disasters. The inevitable is in many if not in most cases simply another name for the unforeseen. It is inevitable that the country will be impoverished if the utilization of wind- and water-power and the transport of that power by electricity are not wisely safeguarded and provided for; but when a survey of our resources, the circulation of the air over our islands, and the effects produced by the interposition of the mountains, plateaus, and valleys upon it, plainly points to the possibility of such a trouble, it only becomes inevitable as a result of culpable negligence.

These two examples, which will not strike any one whose mind is wholly occupied in paying the penalties of old neglect, illustrate my contention that a complete geographical description based on full investigation is of the highest and most urgent importance, not for this country only, but for the Empire, and for every country in the world.

Nor is it the land alone which claims attention. It is of the utmost importance to investigate and evaluate the resources of the surrounding seas. The recent International Conference for the exploration of the sea held at Christiania formulated a scheme of research which has been taken up enthusiastically by Belgium, Holland, Germany, Denmark, Russia, Sweden, and Norway. Its object is to place the fisheries of Northern Europe on a scientific basis, and to make for that purpose a comprehensive survey of the sea, which will prove of high value to meteorology, and through it to agriculture as well. The recent work by Mr. H. N. Dickson on the circulation of the surface waters of the North Atlantic in conjunction with similar work by Prof. Pettersson in Sweden shows how hopeful such researches are from the purely scientific standpoint, and their practical importance is no less. It remains with our Government to show that this country is not indifferent to an opportunity, such as has never presented itself before, of placing one of our great national industries on a basis of scientific knowledge. This is in my belief one of the cases in which the expenditure of thousands now will mean the saving of millions a few years hence.

It is magnificent to send out polar expeditions; they speak volumes for the greatness of the human mind that can give itself to the advancement of knowledge for the sake of knowledge, knowing that it will bring no material gain; and I trust that such a spirit will continue to manifest itself until no spot on Earth, no land however cold or hot, no depth of sea, no farthest limit of the atmosphere, remains unsearched and its lesson unlearnt. But I insist that the full study of our own country is on a totally different footing. Magnificent it may be, too, but sternly practical, since it is absolutely essential for our future well-being, and even for the continuance of the nation as a Power amongst the states of the world. Still, there is every probability that such work will be neglected until the events

which it should avert are upon us, and then it will be too late to make provisions which now could be done cheaply, easily, and effectively.

A Proposed Remedy.

The few attempts which have been made in this country to promote the study of geography or to diminish the discouragements to geographical research have had but slight success. Much has been done to improve geographical teaching by the Royal Geographical Society, the Royal Scottish Geographical Society, the Geographical Association, this Section of the British Association, and other bodies; but that is not my theme. I refer to the little that has been done towards the elaboration of a geographical theory and the elucidation of geographical processes. Amongst the not inconsiderable number of teachers of geography in the universities and colleges of Great Britain there is not one man who receives a salary on which he can live in decent comfort so as to devote all his time, or a substantial part of it, to geographical research; and the same is true of every official of all the geographical societies. Not one is paid a salary sufficient to enable him to devote the time not occupied by mechanical routine to any other purpose than supplementing his income by outside work—writing text-books, correcting examination papers, perhaps even practising journalism. If by an effort and the sacrifice of some of the comforts considered necessary by most people of the professional classes he devotes a few odd hours now and then to some original research, he finds very few to consider it seriously; some friendly expressions of opinion possibly, but scarcely a reader; and it counts for nothing, save, perhaps, in enhancing the reputation of his country in other lands where scientific work, no matter in what department, is valued in a due degree. All this must be changed before much progress can be made. No doubt a giant of genius would ignore all obstacles and pursue his work regardless of recognition; but such giants are not to be looked for many times in a century. It should be made possible for a man of fair abilities to receive as much opportunity, encouragement, recognition and reward for good work in geography as for good work, let us say, in chemistry or electricity. That is all that can reasonably be asked, and that is what is freely accorded in other countries where the status of the man of science is higher than it is with us. It is here that help may be hoped for from the Scottish Universities in the strength of their new endowments. If a Chair of Geography were instituted with the purpose of promoting research first and teaching afterwards, properly equipped with books, maps, and apparatus, and held on the understanding that no outside work was to be undertaken, something might yet be done to restore our country to the position it held a century and a half ago, when a text-book of geography was published without a thought of sarcasm, containing a frontispiece representing "Britannia instructing Europe, Asia, Africa, and America in the Science of Geography."

GEOGRAPHICAL CONDITIONS AFFECTING BRITISH TRADE.*

By GEORGE G. CHISHOLM, M.A., B.Sc.

I HAVE often been led to think that foreigners who endeavour to arrive at a knowledge of English ideas from a perusal of our periodical literature, must be greatly struck by what seems to be the Englishman's delight in self-depreciation. This spirit would appear to be conspicuously manifest in connection with British

* Paper read at the Glasgow Meeting of the British Association, September, 1901.

trade. Leader-writers, contributors to magazines, British consuls, popular authors of jeremiads and ichabodiads write on this subject, if not with unanimity, at least, for the most part, with a harmony that must be, and in fact is, very comforting to our competitors, but far from cheering to the representatives of British trade and industry. So much does the spirit to which I refer prevail, and so completely does it carry with it to the British public its own evidence, that it absolves those who are properly animated with it from the necessity of any laborious inquiry into facts. Like all luminous ideas, it gives to the possessor a preternatural power of insight, which enables him to penetrate with swift incisiveness to the true cause of phenomena which might otherwise be hard to explain. If figures show that in a particular period, or even in a particular year, British trade with some part of the world has been declining, or even has not been advancing so rapidly as that of some other country, that is promptly accounted for. Somehow or other it must be due to our own negligence. "At present our supremacy [in trade] . . . is seriously threatened. . . . Without inquiring too closely how far this relative inferiority [in rate of expansion] is due to the diminished efficiency of our workmen, or the want of initiative and enterprise on the part of the masters and their staff, we may take it as self-evident that we are bound to neglect no means of improving, to the utmost, our processes of production and our machinery of distribution." * The words I have just quoted are from a leading organ of public opinion, and I think they will be readily recognized as a typical comment on the apparent tendencies of English trade.

But in this current of opinion I am not able to join, and the reason is that, however much British trade may be affected by the backwardness or enlightened enterprise, slackness or energy of those concerned in British commerce and manufactures, there are also important geographical conditions to be taken into account. And with regard to these I find myself in the same unfortunate position as I have been in before in addressing a meeting of the British Association—that of having nothing to say but what is obvious, and my only excuse is that, however obvious and large the facts may be, people won't look at them.

Of the influence of geographical conditions on trade and industry, we could have no better illustration than in the history of the great city in which we are now met. Throughout the period in which Scotland had a separate history from that of England, Glasgow was notoriously a quite unimportant town. Its population was ascertained in 1708, the year after the union of the English and Scottish parliaments, and was then found to be under 13,000. At the present time, disregarding municipal boundaries, with which geographers have little or nothing to do except to express a natural irritation at the way in which they are misled by them, and taking in the contiguous places which form along with the so-called Glasgow one industrial and commercial aggregate, we find that the total population exceeds 900,000; and Glasgow is known all over the world as one of the greatest industrial and commercial centres of the globe. Now, is there any one who would ascribe this difference solely to the superior enterprise and ability of the people of Glasgow at the present time as compared with those of past centuries? The true cause of this difference is, in fact, well understood. The geographical and economic situation of the Glasgow of the past cannot be more comprehensively and compactly described than in the words of one of your own citizens. "The city was planted on the western limits of civilization. . . . It was remote from the great lines of mediæval intercourse from which the commercial grandeur of Venice, Antwerp, and other wealthy cities had been acquired. It was a poor little town,

* *Standard*, January 18, 1901.

planted in a very poor and thinly peopled country, within reach of a small river which, flowing towards a highland region peopled by wild and lawless races, fell into a trackless and unexplored ocean. Thus, with indifferently fertile land, with a variable and rigorous climate, with no natural wealth nor valuable products calculated at that time to excite the cupidity of commercial communities, . . . individual enterprise and commercial expansion were not to be looked for." *

A change took place at the union of the English and Scottish parliaments. The Scotch everywhere grumbled, lamented, and profited, just as the English might have done in similar circumstances. By this time the trackless western ocean was explored. Markets had begun to grow up on the other side of it. These markets were largely in English hands, but the union opened them also to the Scotch, and of this Glasgow promptly took advantage. Now here, in order to explain the comparatively rapid rise that then took place in the fortunes of Glasgow, we have to notice one geographical fact of great importance. It is that the physical configuration and outline of Scotland give to Glasgow, as its hinderland in relation to this western or transoceanic trade, not merely the small and "indifferently fertile" basin of the Clyde, but the whole of the eastern lowlands of Scotland from the Grampians to the Cheviots, which under former conditions were infinitely more favoured by nature than the western side of the country. Glasgow had long seen the desirability of improving the Clyde navigation. It was concerned with other towns on the Clyde in making efforts in that direction as far back as the middle of the sixteenth century; but these first and other subsequent efforts in the following century were futile. Not till after events had brought the great hinderland just mentioned in relation to profitable markets in the west was it really remunerative to carry out the great and almost uninterrupted series of improvements which justify your local saying, "Glasgow made the Clyde—the Clyde made Glasgow." Not till the latter part of the eighteenth century could Glasgow be reached by boats of more than five tons. It hardly needs to be pointed out how enormously the local advantages of Glasgow have been increased by the great invention of one of your own citizens, which gave a totally new value to the deposits of coal and excellent iron ore in the immediate neighbourhood of your city.

Glasgow, however, I take merely as an illustration of my main thesis, the importance of attending to geographical considerations. It is now time to turn our attention to the special subject of the present paper, the geographical conditions affecting the commerce of the United Kingdom. For the purpose of our present investigation it will be well to distinguish between conditions affecting commerce and those affecting industry, even though these are inter-related, and act and react on one another.

The advantages of the United Kingdom for a widespread commerce are universally recognized, but it is important to note at the outset that the merely commercial advantages of this country exist solely in relation to those parts of the world that are most easily reached from the seaboard. That, of course, is saying a great deal, and the importance of this consideration is seen to be all the greater when we consider the facts a little more narrowly. It cannot, indeed, be contended that this country has any special advantages arising from its situation in relation to commerce with the East. Italy, which for a long period in the past successfully turned to account its special advantages in relation to this commerce, may perhaps some time in the future come to benefit once more in a marked degree in the same way. England, however, has undoubtedly special advantages of situation in

* 'Glasgow: Its Municipal Organization and Administration,' by Sir James Bell, Bart., and James Paton (1896), p. 4.

relation to commerce with Europe and America, and when we consider the climatic and other conditions likely to affect the development of industry in these parts of the world in the future, so far as we now have the means of making any forecast, it may, I think, be contended that the merely commercial advantages of England are unparalleled, and are likely to remain without a parallel, in any other part of the globe of equal extent.

The extent of this advantage is, it seems to me, strikingly illustrated by the great magnitude and remarkable constancy of the *entrepôt* trade of the United Kingdom, that is, the trade in commodities collected from all parts of the world, and afterwards dispersed unchanged over other parts of the world. Taking the average of five years, we find that the value of foreign and colonial merchandise, exclusive of transhipments, exported from the United Kingdom has been uniformly about one-fifth of the total value of the exports from the period 1866–70 down to the latest period 1896–1900. It has not, in any of these successive periods, been two per cent. either above or below the proportion stated, notwithstanding all the fluctuations that the total commerce of the country has meanwhile undergone. This is all the more striking when we consider that there have been great variations in the mode in which the total *entrepôt* trade is made up. In the beginning of the period now considered, cotton was the most important item in this trade; for a long time cotton has been displaced by wool. Raw silk was at one time an important item; it has now sunk to absolute insignificance. Rubber was formerly unimportant; it is now steadily rising to a more prominent place in the list. The important point to note in the present connection, however, is, not the details, but the fact that so far losses under this head in one direction have been made good by gains in another.

Now, such a trade as this necessarily involves and therefore illustrates advantages of commercial situation, but it would be a gross and obvious mistake to put it down solely to such advantages. This trade is pre-eminently an illustration of the law that to him that hath shall be given. It is in a large measure due to the special advantages which this country enjoys for carrying on a large export and a much larger import trade based on its own resources.

Perhaps an even more striking illustration of the merely commercial advantages of this country is to be found in the history of the cotton trade. It cannot be contended that the industrial advantages promoting the cotton manufacture in this country are as great as those in favour of the woollen industry. We have no home supply of raw cotton, but we have a large local supply of raw wool of special value for certain purposes, which not only furnishes material for a great part of our manufacturing industry, but leaves a surplus for export larger then the estimated amount exported when English wool was of such high value in the middle ages. Yet the English woollen industry never attained that extraordinary pre-eminence which was very speedily acquired by that of cotton after the introduction of steam-driven textile machinery, and which it still retains. According to the latest statistics, all branches of the woollen industry in the United Kingdom, namely, woollen in the special sense, worsted, and shoddy, occupied not much more than half as many persons as the cotton industry,* which now engages more employees than any other industry in the country except agriculture and coal-mining. But there is one great commercial difference between the two industries. The great markets for woollens are the most highly developed industrial countries. The markets for cottons are everywhere; some of the most important in tropical and

* In 1896, number of persons engaged in the cotton industry, 532,920; in the three branches of the woollen industry, 284,441.

sub-tropical countries industrially backward. From any one producing country the bulk of these markets must be reached from the seaboard, and hence in relation to this trade England has had from its origin a very important commercial advantage.

Now, if the general thesis may be accepted that the United Kingdom has pre-eminent commercial advantages with respect to markets approached from the seaboard, there are a few corollaries which should be borne in mind. It follows that the improvements in ocean navigation tend in the aggregate more to the commercial advantage of this country than any other. Some of these improvements have tended peculiarly to the advantage of this country. Among those may be mentioned the change from wood to iron and steel as ship-building materials, and still more the change from wind to steam as a means of propulsion. The possession of the field of the best steam-coal in the world, in a position so convenient as that in which it lies in South Wales, is an enormous benefit to this country. There are other improvements the advantage of which is more general—the enlargement of ships, the various improvements in marine engines to which your city has so largely contributed, the enlargement and improvement of harbours all over the globe, and the improvements in the means of communication between the seaboard and the interior. All these improvements tend more or less to the advantage of all maritime countries, even to that of some that are not maritime. Some individual improvements tend more to the advantage of other individual countries than England; but, on the whole, the United Kingdom is more benefited by such changes than any other single country.

If an improvement in the means of communication between the seaboard and the interior is to be looked upon as a circumstance specially favourable to British trade, still more favourable must be any important extension of the seaboard into the interior. Now, this is practically what is getting tested at present in the region of the great lakes of North America. If it turns out that ocean ships can really be economically used on the improved canals of the St. Lawrence (in which there is now a minimum depth of 14 feet), that means that a great addition is made to the seaboard (though not, it must be remembered, an easily accessible seaboard) in one of the most important commercial regions of the globe. So, too, a true insight into the situation is shown, at least in one respect, by the offer of a British syndicate to the Canadian route to open up this seaboard by the construction along a still shorter route of the long-talked-of Montreal, Ottawa, and Georgian Bay canal. If constructed in adequate dimensions the canal might not pay the syndicate, but it could hardly fail to benefit British commerce.

But in spite of what has been said as to the increasing commercial advantages of the position of England, I don't think it could be contended that all the considerations above adduced would serve to account for the astounding pre-eminence which the United Kingdom enjoys in the ocean carrying trade of the world. One must also take into account what has already been said in connection with an *entrepôt* trade. The country that has most to carry across the ocean for itself is likely on that account to carry all the more for other countries also.

It cannot be denied, however, that there are some developments of recent years that have tended to diminish the proportion of the ocean traffic of the world belonging to this country. The tendency is for more and more of that traffic to be carried by regular liners, and when the traffic of a port, direct or indirect, with any part of the world comes to be large enough to make a line remunerative, the establishment of such a line in connection with any foreign port is certain to affect the British carrying trade adversely and rather suddenly. Such was the case, for example, in consequence of the establishment of the Messageries Maritimes line to Australia in 1883, and those from Bremen and Hamburg respectively in 1887 and 1888. But

when one considers the admirable communications of such ports as Hamburg, Bremen, Rotterdam, Antwerp, and Marseilles with the interior of Europe, one cannot but feel a little surprise that they have been so slow in encroaching on the domains of British commerce. Possibly this encroachment would have been much more rapid if it had been practicable for European countries to throw down some of the fiscal barriers which commerce must leap there.

But if Great Britain has on the whole decided advantages for commerce by sea, it has no such advantages for any extensive commerce by land. Quite the reverse. Any improvement, therefore, in the means of communication between any foreign inland centre of production competing with British centres of production and an inland market is something that tells directly against British commerce. This I propose to illustrate by reference to the commerce of Germany with surrounding parts of Europe, and that of the United States with Mexico and Canada.

Of all the larger countries of the world, Germany is that which has the best position for carrying on a large external trade by land. It lies in the heart of the most populous and the wealthiest part of the mainland of Europe, in communication with more than one of them by admirable inland waterways, and by rail without break of gauge, with all countries on its land frontiers except Russia,* and also through Switzerland and Austria with the rich plains of northern Italy. One of the most instructive illustrations of this advantage is given in an English Foreign Office report. The author of this report, Mr. Mulvany, H.B.M.'s consul at Düsseldorf, mentions that before the Franco-German war the Paris gasworks obtained their coal from his district, and that after the war the trade was promptly revived, and points out that there is, of course, an "immense advantage in being able to send the coal direct into the consumer's yard in the trucks loaded at the colliery screens."† When one remembers the amount of international bitterness to which that war gave rise, one perceives all the more clearly how great the advantage must have been in that commerce.

In the third edition of my 'Commercial Geography' I have already mentioned a fact that illustrates, as it seems to me, very plainly the effect of the establishment of one of the means of communication across the Alps just referred to. In 1880 60 per cent. of the total imports into Italy of iron bars, rods, etc., of a thickness of one-fifth of an inch or upwards (the largest head of iron and steel imports generally) was from the United Kingdom, only 2 per cent. from Germany; in 1890 less than 22 per cent. was from the United Kingdom, more than 52 per cent. from Germany. Now, the Italian statistics enable us to distinguish the imports (and exports) by sea from those by land, and hence we learn that more than nine-tenths of the German total came by land, whereas all the English import was by sea. That means that the great bulk of the German import came through the St. Gothard tunnel, which forms a very direct communication between Italy and the great iron and steel working districts of the Rhine basin. But in 1880 there was no St. Gothard tunnel, and that fact would seem quite sufficiently to account for the difference. If so, we have here a case of loss of English trade entirely due to a geographical cause, and not involving the supposition of "diminished efficiency" on the part of our workmen, or "the want of initiative and enterprise" on the part of English masters and their staff. And later figures on this point are also instructive. Taking those for 1897 (the latest that happened to be available at the time), I found that practically the same percentage of

* Russia has a 5-feet gauge; the other countries have the normal English gauge of 4 feet 8½ inches.

† Foreign Office Report, Miscellaneous Series, No. 454, p. 8.

the same class of goods was imported from Germany as in 1890, but that the British percentage had grown from 22 to 34·6. Apparently Germany had taken full advantage of the St. Gothard tunnel by 1890, and was not able to encroach further in the direction indicated on British trade.

And it must not be assumed that all imports from the United Kingdom into Italy come by sea. In the case of some goods that mode of carriage does not pay. The bulk of English cotton yarns, for example, that reach Italy enter that country by land. In such trade, therefore, England is obviously at an even greater disadvantage commercially, as compared with continental centres of production. How important for German commerce with Italy the land connections are may be guessed from the fact that, while in 1899 the quantity of goods exported from Germany to Italy was 242,095 metric tons, the total tonnage of ships cleared with cargo from German ports in the same year to Italy and Malta was only 42,537. I say "guessed," for we cannot tell what quantity of goods may have been sent from Germany to Italy in that same year by sea from foreign ports (Rotterdam or Antwerp).

Let us turn now to similar relations between the United States and its neighbours on the land frontiers. There was no railway connection between Mexico and the United States till 1884, in which year the Central Railway was opened connecting the city of Mexico with the United States railway system at El Paso, about the middle of the frontier. There are now three other railway connections between the two countries, two of them connecting the city of Mexico with the United States at other points, and one connecting the Southern Pacific railway with the Mexican port of Guaymas. The effect on the destination of the exports from Mexico was apparently very speedy and very marked. Here at least are the figures:—

VALUE OF EXPORTS FROM MEXICO IN THOUSANDS OF POUNDS.

	1883-4.	1884-5.	1888-9.	1899.
To United States ...	4546	5385	8510	11,068
„ United Kingdom ...	4026	3201	2611	987

These results are by no means surprising when we consider that the great bulk of the exports from Mexico consists of silver ore, silver, and partially refined silver, all commodities easily capable of standing the cost of long railway transit, and a great deal going to the smelting and refining centres of Colorado, with which the first railway to the United States established a very direct connection.

The import figures are also interesting, though, I believe, there are no returns on this head so early as 1884–5.

VALUE OF IMPORTS INTO MEXICO IN THOUSANDS OF POUNDS.

	1888-9.	1899.
From United States	4722	5509
„ United Kingdom	1320	2072

Under this head, it will be observed, the United Kingdom holds its own much better than under that of exports. The imports, chiefly manufactured goods, are largely of a kind that come from the eastern parts of the United States, parts

that naturally make use of ocean carriage. On the whole, however, the competition between the two countries in Mexico is one between land and sea transport, and as the people of the United States find their interest in improving the railway connections between their interiors, so the English find their interest, in accordance with what has been already said in general terms, in the improvement of the ports of Vera Cruz and Tampico, and of the connections between these ports and the interior.

Canada, with its enormous land-frontier bringing into connection at many points some of the more populous parts of the Dominion and its neighbour, not, as in Mexico, through a uniformly sparsely peopled region, is in some respects an even more striking illustration of the importance of land connections than Mexico. These connections are constantly becoming more intimate, with unmistakable effects on the commercial relations of Canada with the United States and the United Kingdom respectively, though, from the difference of the circumstances, these effects are of a somewhat different nature. Canada has some exports of a similar nature to the leading exports of Mexico, and these go largely, if not chiefly, to the United States for the same reasons as those of Mexico. Under this head may be included nickel matte as well as silver and gold ores. But these do not form the bulk of Canadian exports. Most of the exports from Canada are similar to those which are produced in abundance, if not in excess, by the contiguous parts of the United States, and such as have a special value are to a large extent kept out of the United States by heavy fiscal duties. Hence the Canadian exports go in increasing proportion to Europe, principally to the mother country. But it is otherwise with Canadian imports. These are largely of a kind in which the United States and the United Kingdom compete with one another, and the United States have obvious local advantages in the competition.

First, it must be remembered that English goods are landed at furthest at Montreal, and that only during the summer months. Now, more than half the population of Canada is found to the west of Montreal. However cheap, therefore, carriage in bulk by sea may be, there is an addition to the cost of transport arising out of the break of bulk and a longer or shorter railway journey over and above. In the case of Toronto, the great distributing centre for Ontario, the length of the railway journey is 338 miles. Now, Toronto is within a much shorter distance of several producing centres in the United States without break of bulk. And if this is an important consideration with respect to the central and some parts of the eastern districts of Canada, it is obviously of still greater importance in the case of the western provinces in relation to such producing or jobbing centres in the United States as Chicago and St. Paul.

That, moreover, is by no means the only way in which the United States competition is favoured by the intimacy of the railway connections with Canada. It is hardly needful to remind you of the important part played by commercial travellers in promoting trade. There is nothing that our consuls so frequently remind us of, and it is often pointed out that commercial travellers from the United States are much more numerous in Canada than those from England. Very true, no doubt; but how can it be otherwise? However much transport may have been cheapened, man still remains an expensive commodity to carry, especially when you take into account the loss of interest on capital during the period of transit, that is, the loss of the traveller's time. Now, I do not suppose that the numerous commercial travellers in Canada, representing firms of the United States, come from New Orleans, San Diego, and such outlying parts. A good many of them, no doubt, come from Detroit and Buffalo, where the travellers have only to cross the border to get into Canada. One can imagine a commercial traveller

saying to his wife in the morning, "I shall not be back to dinner to-day; I am going to London," meaning London, Ont., or a Buffalo traveller making the same explanation with regard to Hamilton. Montreal is not so far from New York as Glasgow or Edinburgh is from London, and can be reached in a short night journey. London, Ont., is only 114 miles, or 4½ hours from Detroit, and Toronto 229 miles, or 7¼ hours. Hamilton is only about 70, and Toronto little more than 100 miles from Buffalo.

Obviously, too, contiguity favours trade between the United States and Canada in perishable commodities, such as either cannot be conveyed at all between Canada and Europe, or only at extra cost.

Further, imports from the United States into Canada are favoured by another geographical condition, which does not necessarily result from contiguity, but is due to the fact that these two countries, or at least the adjacent portions of them, have a similar climate, and have grown up under similar economic conditions. Agricultural settlement is rapidly taking place in both, and the cultivated areas are similar in surface features, in climate, and in economic requirements. The same kind of agricultural machinery is used in both, and more largely used in the United States than anywhere else in the world. Now, production can always be carried on more cheaply on a large scale than a small one, and hence it is natural, one might say inevitable, that the United States should manufacture this machinery for Canada.

The similarity of the winter climate causes the use of the same means of guarding against it in both countries. The method of domestic heating suitable enough for the mild and uncertain winters in England, is altogether unsuited for the regular and severe winters of Canada and the United States. In both these countries the same kind of stoves and the same kind of fuel are used domestically. Large manufactures of such stoves are carried on at Detroit, and without the slightest doubt the manufacturers of these stoves find an immense market in the adjacent parts of Canada as well as in the adjacent parts of the country to which they belong.

With all these conditions favouring the commerce of the United States, it is not, therefore, to be wondered at that the percentage value of the imports of the Dominion of Canada from the United Kingdom, reckoned on the total value of the imports, has declined from about 51 in the year 1867–8 to about 24 in 1898–9, while that of the imports from the United States has gone up in the same period from about 36½ to 62½; and that these movements have scarcely been arrested by the recent preferential tariff in favour of the products of the United Kingdom. This last circumstance is indeed the less surprising when we consider that the Canadian free list includes anthracite (the Pennsylvanian fuel required for domestic purposes), coke, various kinds of timber, hides, cotton, wool, and other important commodities, to which the favouring conditions indicated above apply in their full force.

We must now proceed to consider the industrial position of the United Kingdom and her rivals. The industrial pre-eminence of England may be said to have been first attained in the early part of the eighteenth century. It was then largely based on the possession by England of a great abundance of excellent wool, combined with the advantages of her commercial situation. Her industrial advantages were, of course, enormously enhanced by the inventions which, towards the close of the eighteenth century, gave an entirely new value to her extraordinary wealth in coal and iron ore in remarkably convenient situations. Directly or indirectly, these inventions have led to an increase in the production of coal in the United Kingdom from an estimated total of about 10,000,000 tons in 1800 to one of 225,000,000 tons in 1900.

If England had been the only country possessing these advantages, then the relative position of this country in manufacturing industry might perhaps have been maintained for an indefinite period, and even increased; but it does not follow that this country would have been so rich as it now is. But of course this country is not the sole possessor of such wealth, and although, owing to historical circumstances, this country was the first to turn such wealth to account, other countries possessing it were sure to do so in time, and it was mathematically certain that as they did so the relative position of England would be lowered. England may have still, probably indeed has, greater industrial advantages than any other area in the globe of equal exent, but they are not greater in the same degree as they once were.

This is so obvious that it does not need to be enforced in general terms; still, a few details are worthy of attention. One country on the mainland of Europe, far advanced in its general economic development, is well known to be very rich in coal, and that coal also is, to a large extent, very conveniently situated. The country to which I refer is, of course, Germany. One of the two largest coalfields of this country, that of the Ruhr basin, is contiguous to the Rhine, and is throughout its length of 60 miles in water-communication with that river, a river whose valley has been a highway of commerce from north to south in that part of Europe, and hence a means of attracting and condensing population, from prehistoric times downwards. The coalfield has many easily worked seams. Within 150 or 160 miles of that coalfield are two of the most important groups of iron-ore deposits on the mainland of Europe. One of these groups lies about 70 to 90 miles south-east of the Ruhr basin, in the hilly country where the Prussian provinces of the Rhine, Westphalia, and Hesse-Nassau meet. This group produces ore of three or four times the value of the ores of the other group, which is situated partly in and partly on the borders of the grand-duchy of Luxemburg (part of the German Customs Union, it will be remembered), at the distance of 150 to 160 miles from the coalfield. The ores of this group, though less valuable, are much more easily worked, and hence form about two-thirds of the quantity of the total iron-ore production of the German Customs Union.

Now, in these circumstances it is surely not to be wondered at that the coal and iron fields mentioned should come to be opened up, and that there should follow a considerable development of the various industries that have been fostered by the wealth of coal and iron. Indeed, when all the facts are considered, what does seem to demand explanation is, not that Germany should have come to be a competitor with this country, but that she should have been so long about it. It does seem surprising that the first coke blast-furnace in the Ruhr basin should have been blown in only early in the forties of last century, that the first railway of this region, from Cologne to Minden, should have been opened only in 1846; that as late as 1860 the total production of coal within the territory of the present German Empire (which has several other well-placed coalfields) should have been under 12¼ million tons. Since 1860, however, the production has increased apace, and with it have grown all kinds of industries. Our own country has thus inevitably been placed in a lower relative position industrially, but surely the facts just stated are enough to indicate that this does not necessarily imply either "diminished efficiency of our workmen or the want of initiative and enterprise on the part of the masters and their staff." That, in fact, it is not always so, that in some branches of industry we still enjoy a confessed superiority, is sometimes made plain enough by the testimony of our rivals. A writer in a Leipzig periodical connected with the textile industry complains that the finer and very fine cotton yarns "have remained insufficiently protected against the overpowering competition

of Great Britain and Switzerland, with the result that the spinning of fine yarns has not progressed, and is only able to develop slowly and at a sacrifice." He goes on to point out that "the German cotton-spinning industry is unfortunately obliged to import almost the whole of its machinery from the United Kingdom," and adds that it does not redound to the credit of German engineers that, since the establishment of the German Empire, practically nothing has been done to render the German spinning mills independent of the British machinery builders. "The reproach that the German finer yarn spinning industry has not progressed to the extent expected by consumers of these yarns may be laid at the door of these latter themselves, and demonstrates their ignorance of the unfortunate history of this branch of the cotton industry. The finer yarn spinning industry has been continually disturbed. In 1878 it was granted a moderate duty; early in the eighties the question of customs drawbacks was brought forward; then, in 1893, the protective duty was reduced in the way of treaties; and likewise since that time the industry has not been left in peace—agitated from all sides and defended by none. Could it, under such conditions, be seriously expected to progress?"

In all this there is nothing to the discredit of British industry, but very much the reverse; but perhaps after all the most interesting thing in this quotation is the illustration it affords of the keen business-like sense, not without parallels in our own country, of the injury done to trade by the selfishness of other people.

On the other side of the Atlantic there has, meantime, been growing up another keen competitor, which it is utterly absurd to suppose that this country can permanently rival in the magnitude of its foreign commerce. The difference in magnitude and the extent of the natural resources will in time make the comparison altogether out of the question. These resources include fields of coal, and probably also of iron, of greater extent not merely than those of the British Isles, but those of all the countries of Europe together. And in this case there is no reason to speak of any tardiness in their development. They have been opened up and worked with as much rapidity and energy as there was any reason to anticipate. It is true that none of the coalfields of the United States are so conveniently situated with respect to the seaboard as those of Great Britain; but, as above indicated, this fact places them and the industries dependent on them at no disadvantage, as compared with competing industries of the United Kingdom, in relation to the great bulk of the local markets. These markets are for the most part inland, not so easily reached from the seaboard as from inland centres of production.

Thus, then, a vast change is brought about in the relative industrial position of the United States not ascribable to any negligence on the part of British manufacturers or merchants.

Then there is another point to consider. Our mines have been longer worked than those of any other country, except perhaps Belgium. An inevitable consequence is that the seams most easily reached and worked are to a large extent worked out. We are compelled to work our thinner seams, or to reach thicker seams by deeper shafts and more extensive tunnelling. On the other hand, the American mines are still worked for the most part only to a comparatively small depth, in many cases by means of level-workings opening on hillsides (as in the case of a few of our Welsh mines). Coal, too, has been cheapened in America, in many cases by increasing demand favouring the economies due to working mines on a large instead of a small scale, as well as by a large amount of immigration of miners from parts of Europe in which a lower standard of living prevails. In these ways the average price of coal in America, and especially in certain parts of America, has been on the whole gradually lowered, while that in

our own country, and in other European countries, has remained fairly stationary or risen. This is shown by the following table, in which, besides averages for entire countries as given in the Coal Tables annually issued as a parliamentary paper, I have also inserted, in order to give more definiteness to the comparison, for some years the averages of certain states of the United States and certain districts of Great Britain and Germany:—

AVERAGE PRICE OF COAL PER TON AT THE MINES.

Year.	United Kingdom.	United States.	German Empire.*	West Glamorganshire.	Pennsylvania. Anthracite.	East and West Riding, Yorkshire.	North and East Lancashire.
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
1883 ...	5 7½	6 5½	5 4	—	—	—	—
1884 ...	5 4¾	5 7¼	5 3¾	—	—	—	—
1885 ...	5 2	6 8¼	5 3¼	—	—	—	—
1886 ...	4 10	6 4¾	5 3¼	—	—	—	—
1887 ...	4 9¾	6 6¾	5 2¾	5 4	8 3½	4 9	5 3
1888 ...	5 0¾	6 0	5 3½	5 10	9 1	5 1½	5 6
1889 ...	6 4¼	5 3½	5 9½	8 3	6 8½	6 3	6 8
1890 ...	8 3	5 2¾	5 9½	10 9	7 4½	8 9	8 1
1891 ...	8 0	5 3½	8 1½	10 10	6 9	8 3	8 3
1892 ...	7 3¼	5 4¾	7 6	9 3	8 0	7 9	7 6½
1893 ...	6 9½	5 4	6 10	7 9	8 0¾	7 2	7 10
1894 ...	6 8	5 1	6 8½	7 9	7 2¾	7 4	7 4½
1895 ...	6 0½	4 9½	6 11	7 4	7 2¼	6 5	6 7½
1896 ...	5 10¼	4 9½	7 0	6 10	—	6 5	6 3½
1897 ...	5 11	4 7½	7 3	6 9	—	6 7	6 3½
1898 ...	6 4½	4 5	7 6	6 10	7 2½	7 0	6 4¾
1899 ...	7 7	4 8½	7 11	7 8	7 11¾	7 8	7 6¾
1900 ...	10 9¾	5 5½	9 0	—	—	—	—

Year.	Northumberland.	Pennsylvania. Bituminous.	Illinois.	Alabama.	Dortmund. Steam and coking coal.*	Dortmund. Puddling and good steam coal.*	Upper Silesian gas coal.*
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
1887 ...	4 7	4 2½	—	6 0¾	5 8	4 6	6 0
1888 ...	4 4	4 5	5 3	5 5	6 1½	5 7	6 0
1889 ...	5 5	3 7	4 6½	5 2	8 7½	7 6½	7 1½
1890 ...	7 7¾	3 9	4 6	5 2	10 11	10 0	9 8
1891 ...	7 4	4 0¾	4 3	5 0	10 0	8 1½	9 4
1892 ...	6 6½	3 7½	4 8½	4 8	8 7½	7 5	9 3
1893 ...	5 11½	3 1¾	4 5½	4 5½	7 5½	6 7	9 2
1894 ...	6 7	3 3½	4 2½	4 2½	8 1½	7 0	9 2
1895 ...	5 6¾	3 3¾	4 3½	4 2½	8 1½	7 6½	9 2
1896 ...	5 0¾	—	—	—	8 4½	8 0	9 1
1897 ...	5 3	—	—	—	—	—	—
1898 ...	6 1¼	2 9½	3 7½	3 11½	—	—	—
1899 ...	7 0⅝	3 8	3 7½	4 8	—	—	—

The very considerable fall in the price of Alabama coal must have afforded a

* In these columns the values given are not in the original sources, but are altered so as to correspond to a ton of 2240 lbs. instead of the metric ton of 2205 lbs.

great stimulus to the development of the iron and steel industry in that state, where coal, excellent iron ore, and limestone are all found close together at the southern end of the Appalachian system. It is from that district that most of the iron and steel recently exported from the United States to various European countries, including the United Kingdom, is derived.

The northern iron and steel working centres have not the advantage of obtaining coal and iron ore near one another; but that is compensated by the fact that these centres can be supplied with any amount of excellent iron ore well adapted for steel-making by the Bessemer and open-hearth processes from deposits worked with extraordinary facility in various hill ranges, the Marquette, Menominee, Gogebic, Mesabi, and others, round the head of Lake Superior, in the states of Michigan, Wisconsin, and Minnesota. Some of these deposits were discovered quite recently, those of the Gogebic range in 1884, those of the Mesabi range in 1892. The production of the Gogebic range rose from about 1000 tons in 1884 to upwards of 1,285,000 tons in 1887. Such discoveries must obviously have exerted a great and rapid influence on the development of the iron and steel of the States. The ore is quarried in the open air, and, after a short haul to a lake-port, is transported with extraordinary cheapness in whaleback steamers to Chicago, Lorain, Cleveland, Ashtabula, Conneaut, or some other lake-port, in some of which iron and steel works already exist, though the bulk of it is carried further on to older iron-working centres in the interior. All these ranges round the head of Lake Superior now yield considerably more than two-thirds of the total production of iron ore in the States.

And these are not all the natural advantages of the States with respect to this one industry. Fuel is available not only in the form of coking coal, but also in those of petroleum and natural gas, both in great abundance. Moreover, the market of the States is unique in the world as regards extent and value combined. There is no other population in anything like the same economic condition offering so large a market absolutely unimpeded by fiscal barriers. This last condition favours in a peculiar degree that colossal production centralized in a few places for which the States are remarkable, and this circumstance again favours the maintenance of remarkably low railway rates for the carriage of large quantities of goods long distances between certain points.

With all these advantages, one would hardly have imagined that fiscal barriers around this great market would have been necessary to prevent competition within it; and it is at least not surprising that the United States has surpassed this country in the production of pig iron and steel since 1890.*

The distance from the seaboard of both the coal and iron of the United States has hindered that country so far from becoming a serious competitor with the United Kingdom outside of America except in the case of the more expensive finished products, such as machinery. But there are other parts of North America more favoured. Canada has coal on the seaboard both in the east and west; and with the coal and limestone deposits of Sydney, Cape Breton, and the iron ores of Belle Island, Newfoundland, blast furnaces have now been started at the former place with the view of producing iron and steel for sale on both sides of the Atlantic.

A still greater alteration in the relative industrial advantages of Great Britain may be brought about by the increasing application of water-power. Formerly the benefits to be derived from this source of power were restricted by the fact that it could be used only at the place where it existed, and in such circumstances it was

* The years 1894 and 1896 excepted in the case of pig iron.

in many cases not practicable to use it at all; but now the employment of electricity as a means of transmitting this source of power to places in which it can be conveniently made use of is rendering it much more freely available, both for the working of stationary and locomotive engines, and also for the development of heat.

Now, it is notorious that this course of development must turn out much more to the advantage of the industries of some other countries—Switzerland, Italy, Norway, Canada, the United States—than our own; but there is all the less need for any enlarging on this topic since it was only a few weeks ago dwelt on at some length by the President of the Society of Chemical Industry at its annual meeting in this city. I will only direct a little attention to the electrical employment of water-power in Italy, where, it seems to me, there is a point of special geographical interest in connection with this enterprise.

Italy has a peculiarly honourable place in the history both of electrical science and its practical applications. The very name bears witness to the fact that Italy was the birthplace of Voltaic electricity. To an Italian physicist, Pacinotti, was due the first idea of a dynamo-electric machine (invented in 1860, and first described in the *Nuovo Cimento* in 1867). It was in Italy, at Milan, that the first central station for electric lighting was established on the mainland of Europe (1883). It is to Italians that we owe the recent development of wireless telegraphy. Now Italy, as is well known, has been dealt with by nature in a rather niggardly fashion in the matter of coal. On the other hand, it is rich in water-power. The amount of such force already utilized is as much as 300,000 horse-power, and the amount not as yet utilized, but capable of being conveniently turned to account, is estimated from official sources at 2,800,000 horse-power in round numbers, a total accordingly exceeding three millions of horse-power, calculated, if used day and night, to represent, at the prices of coal in Italy in 1900, an annual value of about 800 millions of lire (say £30,000,000).*

Water-power is already utilized electrically in Italy, not merely for the purpose of lighting and locomotion, but also for the production of hydrogen and oxygen by the electrolysis of water and the manufacture of carbide of calcium, and works are in progress for utilizing the same power in the same way for the refining of copper (at Leghorn), the smelting of iron ore (at Darfo on Lake Iseo), and the manufacture of caustic soda (on the Pescara). An enormous stimulus was naturally given to the application of Italian water-power by the discovery of the processes by means of which it may be transmitted to great distances. To enable Italy entirely to dispense with the use of English coal, it would be necessary for the force developed in the mountains by falling water to be conveyed distances of from 100 to 125 miles. With the use of high tension electricity the transmission of power for even a greater distance has been found practicable elsewhere; and steps are now being taken, if they have not already been carried out, for the transmission of 11,000 horse-power from the torrent of Cellina to Venice, a distance of 56 miles, at a tension of 25,000 volts.

Italy is now looking forward to a great industrial development through the application of her inexhaustible water-power, and the point of special geographical interest to which I would call attention in connection with that is this. Italy occupies, in some respects, a peculiarly advantageous geographical position. That

---

* These and other particulars relating to the use of water-power in Italy are taken from a paper by Giuseppe Colombo in the *Atti della R. Accademia dei Lincei*, Anno ccxcvii. (1900), pp. 478–489.

was made abundantly manifest throughout the history of the middle ages. Though the advantages of that situation were, to a large extent, lost through the discovery of the sea-way to India, they have been in some degree restored by the cutting of the Suez Canal. Nevertheless, these advantages have not yet been greatly turned to account since that date. We must remember, however, the great law of commerce to which I have already referred, "to him that hath shall be given." If Italy, through the development of a great manufacturing industry by means of her water-power, is able to build up a great external commerce based on her own resources, all the more likely is she to add to that trade a great *entrepôt* trade, possibly, and indeed probably, to the prejudice of our own. One thing wanting for this is a great port in a suitable situation. Venice is not adapted to modern conditions. It is too cramped for further growth. But I have often thought that if local conditions allowed of the creation of a great port at Rimini, there might there grow up a new Venice, which might come to outrival in wealth and in commerce, though never in glory, the Venice of the past.

In conclusion, I will venture on one practical remark with regard to our own country. If it is the case that there are some geographical conditions acting in some respects adversely to the development of our commerce, in addition to the keen and enlightened competition of growing rivals, that only adds force to one remark that I have quoted from the *Standard*—"that we are bound to neglect no means of improving, to the utmost, our processes of production and our machinery of distribution." One means of attaining this end, I do not doubt, will be a wise system of education. But I trust that in planning the framework of a system of education with this end in view, it will not be forgotten that all trade is not external (foreign or colonial) trade. There is nothing unpatriotic in expressing the opinion that there would be no cause for dissatisfaction if in the future more of the produce of our industry found markets in Lincolnshire and Norfolk, Lothian and Meath, even if on that account less were sold in Argentina and Peru.

THE MONTHLY RECORD.

EUROPE.

Distribution of Population in the Rhine Province.—One of the careful and elaborate studies of the distribution of population as affected by geographical causes which find special favour among German students, appears in the *Forschungen zur Deutschen Landes- und Volkskunde* (vol. 13, part 3), from the pen of Dr. Ernst Ambrosius. The district selected for study is that on either side of the lower Rhine from Ürdingen and Duisberg in the south to Elten in the north. Taken as a whole this district is marked by comparatively slight variations of level, and the influence of this factor on the movement of population is therefore not so well marked as it often is. Still, Dr. Ambrosius points out, the district may be divided, geographically, into five parallel zones, on the basis of its general relief, and these are taken as its fundamental divisions for the purposes of the study. They are: (1) the line of heights bordering the district on the east; (2) the Rhine valley, including that of the Issel; (3) the groups of hills on the left of the Rhine; (4) the valley of the Niers; (5) the western heights and moors. As a general rule the soil of the river-valleys is composed of rich loam and clay, while on the higher grounds sand and gravel predominate. As might be expected, the population is less dense in the higher zones, where the average per square kilometre varies from

77 to 88, and is congregated chiefly in the river-valleys, especially that of the Rhine, where the average density reaches 241 per square kilometre. Dr. Ambrosius enters very fully into the question of the occupations of the population in their relation to its distribution. In the eastern part of the district, the great aggregation of population is towards the south, in which direction even the sparsely populated eastern zone shows the influence of the iron industry at Sterkrade. In the Rhine valley the industrial towns of the Ruhr district—Duisburg, Ruhrort (the most important river-port in Germany), Meiderich, etc., and Ürdingen, the river-port of the textile industry on the left bank of the river, swell the aggregate of population in the south, while further north, apart from the town of Wesel, which owes its importance to its favourable situation at the mouth of the Lippe, the valley is mainly agricultural. Agriculture is also largely practised in the Niers valley, though silk-weaving, shoe and cigar-making, and some other industries, occupy considerable numbers, especially at the flourishing towns of Geldern and Goch. In the south of this zone, as also of the westernmost of the five zones, the population has diminished of late years, owing to the attraction exercised by the towns immediately to the south engaged in the textile industry.

ASIA.

Survey of India Report for 1899-1900.—The recently issued general report on the operations of the Survey of India Department for 1899–1900, while recording a steady progress in the various departments of the work, has little to tell in the way of new departures or striking operations, most of the surveys carried out during the year being merely continuations of those previously in progress. The principal triangulation in India had during the previous season been linked with the Burma triangulation, and work in this direction was continued by the despatch of detachments for the execution of two minor series, one extending from Manipur to the coast near Akyab, the other connecting this series with the Mandalay meridional. The almost unknown country along the Bengal-Burma boundary has thus received a much-needed attention. Of the parties engaged on topographical work, four have likewise continued to work in Burma, three of them in Upper Burma, the other mainly on the western slopes of the Arakan Yoma hills. The survey of the Lushai hills was continued on the 1-inch scale, and an area of 759 square miles surveyed on that scale. Geographical results of importance are naturally to be expected on or beyond the extreme frontiers of the empire, and the year under review forms no exception to the rule. Valuable surveys were executed by Captain Ryder during a reconnaissance in Yunnan, commenced during the previous season by Captain Davies. The routes were so chosen as to avoid, as far as possible, ground already surveyed, and the result of the season's work was, to use the words of Captain Ryder's report, "that practically every town in the province has now been visited and reported on, every important route and many others have been surveyed and reported on," Captain Ryder's own share amounting to 1400 miles of new routes. The work is so far merely of a reconnaissance nature, no triangulation having been effected, but the results are none the less useful considering the imperfect state of our previous knowledge of the province. Another useful piece of work was done by Captain Robertson during the Mishmi expedition of 1899–1900. The country visited was that of the Northern Mishmis, till then practically unexplored, though a small part of it, as well as the district of the Midu Mishmis, had been mapped by the late Colonel Woodthorpe in 1877–78. The country of the northern section of the tribe is even more rugged and precipitous than that of the rest of the Mishmis. The route followed entailed the passage of a pass 8900 feet above sea-level, the

descent from which to the Ithun, the main stream of the country, was almost impassable for laden coolies. The valleys are everywhere steep and narrow, in places amounting to gorges many thousand feet deep. The slopes, up to 10,000 or 11,000 feet, are covered with a dense mixed forest. Higher up the hills are bare and covered with snow, and glaciers exist in places. Captain Robertson thinks that the Dibang (which where seen had an enormous volume of water) has a larger drainage area than is shown on the maps accompanying A—K's report, but to his great regret he was unable to fix the position of some high snow mountains near its headwaters. Another report deserving mention is that of Major Renny-Tailyour on the concluding season's work of the Burma-China Boundary Commission, while allusion may also be made to the account of a new process for the reproduction of drawings by direct printing upon zinc, which has proved very successful. It is the invention of Mr. Vandyke, of the Lithographic Office, Calcutta.

The Structure of South-East Anatolia.—The regions where the young folded mountains of the Old World abut against the Old World tablelands is of exceptional morphological interest, and has been little studied. Dr. Franz Schaffer, a pupil of Suess, visited it twice in 1900. He gives a summary of his conclusions and a map, whose topography is taken from that issued by the R.G.S. in vol. iii. of the Supplementary Papers, in *Petermanns Mitteilungen* for June. Above the plain of Cilicia, a succession of short, steep-sided, isolated ranges of unfossiliferous limestone rise abruptly, and represent the broken-up relics of pre-Taurus earth-foldings. These strike N.-S., except in the south, where they bend towards the south-west. In the south-west these are covered by the bare limestone plateau of Tracheotis with its Karst landscapes. On the north-west of the plain are the folded mountains of the Taurus, and on the south-east Mons Amanus, Mons Cassius, the Kurd Dagh, and other ranges of similar age. The Taurus ranges strike W.-E. in the south-west, but curve to S.W.-N.E. in the north-west. The Amanus ranges and Cassius are almost parallel to those of the Taurus, and may be regarded as continuations of the north and south Cyprus mountains. The Kurd Dagh is the northern margin of the Syrian tableland affected by the Taurus foldings. The northern continuation of the Jordan-Orontes rift-valley passes from the tableland into the folded region of Eurasia, and can be traced between the Amanus ranges and the Kara Dagh, between Antioch and Marash. Another faulted depression exists north of the Taurus, and extends to the Sakaria. The margins of both are marked by volcanic deposits, which are older than the upper Tertiary deposits. Hence a simple symmetrical arrangement of the features—the Cilician plain is bordered by folded mountain ranges, beyond which are depressions encircled by young volcanic deposits.

The Kizilbash of Cappadocia.—During archæological researches carried out in Northern Asia Minor in the summer of last year, Mr. J. W. Crowfoot found an opportunity to visit some of the Kizilbash villages in the province of Angora, near the eastern bank of the Halys, and the inquiries he made there led to some interesting deductions as to the past history of the people, which are set forth in a paper read before the Anthropological Institute and printed in a recent number of the *Journal* of that body (vol. xxx. p. 305). The traditions and customs still current among the people show, Mr. Crowfoot points out, the great influence still exercised in their minds by the past, memories of the times when they held an independent position prior to the rise of the Osmanli power having not yet died out. Mr. Crowfoot quotes from Purchas' 'Pilgrimage' passages which show that their legends, though no doubt confused, do refer to definite historical occurrences, some of which took place as much as six or seven centuries ago. In the rites and customs still extant among them, notably in the reverence shown to the tombs of

past heroes, he considers that we have the fragments of a pre-Islamic pagan civilization. The people themselves derive their origin from Khorassan, which, as Sir T. Holdich pointed out in a discussion which followed the paper, probably means to them, not the modern province of that name, but the wider area occupied by the Durani empire, which included Afghanistan, Baluchistan, and part of the Punjab, where so many Kizibashis are still resident. Cappadocia has for ages turned to the East rather than to the West, and before the time of Alexander the inhabitants had come under oriental influence and developed a theory of their own, which made them impervious to Greek and Christian missionaries, and which, as described by Strabo, Basil, and Eusebius, can be identified with the practice of the modern Kizilbash. Besides this name, which was originally a term of opprobrium, Mr. Crowfoot found the appellation Bektash in use among the people. The two names, as Sir C. Wilson pointed out, are so wide apart in their original application that their use by one and the same people is difficult to understand. He suggests, however, that the villages occupy land which once belonged to the Bektash Dervishes.

Kozloff's Expedition in Central Asia.—Disquieting news concerning this expedition (cf. *Journal*, vol. xvii. p. 303) was received at Biisk, in Siberia, early in July. A runner from Kobdo brought the intelligence that the party had been attacked by two thousand Tanguts, and though these had been at last beaten off, it was only at the cost of the lives of eight members of the expedition, the position of which was regarded as precarious. It is hoped, however, that the danger has been exaggerated.

AFRICA.

The Earl of Cromer's Report on Egypt* furnishes most gratifying evidence of the country's progress under the able guidance of His Majesty's Agent and Consul-General. The burthens of taxation have been sensibly reduced, and public works are being carried on with energy, yet the revenue exceeds the expenditure. Trade is expanding, and the prosperity of the great body of the people is increasing from year to year. Even the expenditure incurred in the re-occupation of the Sudan—£417,000 in 1901—is borne with ease and without endangering the stability of Egyptian finance. Among matters of special interest, we may mention that a survey of the cataract region to the south of Wadi Halfa is now in progress, and is to be completed in the course of three years. The revenue surveys of the Mudiriyes of Gize and Gharbiye are to be completed by the end of this year, whilst the village and topographical survey of the Fayum, based upon a regular triangulation, is in progress. Triangulations are likewise being carried out on the Mudiriyes of Dakheliye and Kalyubliye. Reports on the geological surveys of the oases are nearly ready for publication.† In the Sudan, Colonel Talbot, in charge of the surveys, is directing operations along the borders of Eritrea and Abyssinia. A full report on the operations of Majors H. H. Austin and C. W. Gwynne has already appeared in this *Journal* (vol. xvii. p. 495), and the latter of these officers has gone to Addis Abbeba to arrange with the Emperor Menelek for a continuation of the survey of the frontier district with a view to the conclusion of a boundary treaty. Colonel Sparkes has gone to the Bahr-el-Ghazal to establish stations. El-Obeid was re-occupied on December 17, 1899, and friendly relations have been established with the

* 'Egypt,' No. 1 (1901).

† On the Geological Survey of Egypt, see *Geographical Journal*, vol. xvii., 1901, p. 597, and the succeeding note in the present number.

Sheikh Ali Dinar of Dar-Fur, the grandson of the late Sultan Husein. Only a small remnant of the Dervishes under Arabi Dafala are still in the field, in Dar Kara, to the south-west of Dar-Fur. If we add that there are now at work eight meteorological stations, fully equipped, between Alexandria and Omdurman, and that Nile gauges have been established on the Blue Nile and the Sobat, it must be admitted that much is being done for extending the geographical knowledge of the vast regions now under the sway of Egypt and her British adviser.

The Farafra Oasis.—Mr. H. Beadnell, of the geological survey of Egypt, whose surveys in the Nile valley and Libyan desert have already been referred to in the *Journal*, describes the topography and geology of the Farafra oasis in a special paper issued by the Geological Survey. The oasis was known previously chiefly from the work of the Rohlfs expedition of 1873–74, and though generally confirming the results then obtained, the recent survey, undertaken in January and February, 1898, has added considerably to our knowledge in various directions. In particular, the position of the oasis in longitude was fixed with greater precision than had been previously the case, Mr. Beadnell having traversed the desert between Farafra and Assiut, which lie almost on the same parallel of latitude, steering due east and plotting his course by plane-table and compass, the distance being reckoned by a good measuring-wheel. Kasr Farafra, the one village of the oasis, is thus placed in 28° 0′ 15″ E. long. as compared with 28° 5′ as given by the Rohlfs expedition. Farafra, the largest of the depressions in the Libyan desert, has an irregularly triangular shape, with the apex to the north. It is bounded on the north, east, and west by steep cliffs, the altitude of the adjacent plateaux being about 800 feet above that of the oasis. To the south, the floor of the depression rises imperceptibly for some 95 miles until the edge of the Dakhla escarpment is reached. A large part, especially on the east and south-east, is covered with blown sand, which in the latter direction assumes the form of high parallel dunes, running about south-south-east. To the west of Farafra, and separated from it by only about 6 miles of high plateau (even this being possibly breached by a strait at one point), is another extensive depression—that of Iddaila—which is still almost unexplored, its very existence having been overlooked until quite recently. Farafra possesses little economic importance, there being only some twenty springs, most of which are situated near the village under the western escarpment. The water from each of them is carefully controlled so as to irrigate a small patch of ground. A survey of the springs was made by Mr. Beadnell, which improves the sketch-map of the Rohlfs expedition in several particulars. Changes appear to have taken place in them, some having become dry, while others have been opened up. In the depression of Iddaila there are two known localities where water occurs, but at one of the wells it is bitter. The other is a running spring of sweet water, used as a watering-place on the roads from Dakhla and Farafra to Siwa. The population of Farafra was 542 in 1897, and the only exports are dates and a few olives. Geologically the floor of the depression (where not covered with blown sand) consists of white chalk, which appears to dip northwards from the Dakla escarpment nearly up to Kasr Farafra. This chalk also forms a step of the plateau to the north-north-east, and the main part of the plateau separating Farafra from Baharia. Elsewhere the plateau consists of Eocene limestone, underlaid by the Esna shales (also Eocene).

The Forests of the Sudan.—Among the many beneficial results of the new *régime* in the Eastern Sudan, the attention which is being directed to the conservation of the forests, hitherto quite neglected, will be not the least important. The Director of Forests under the new administration, Mr. C. E. Muriel, has lately devoted six months to a tour in the Sudan for the purpose of examining the

principal existing forests, and studying the most suitable means for their maintenance and exploitation. His report, dated May, 1901, deals in the first place with the distribution and present condition of the forests, and in the second with their treatment from the point of view of timber, fuel, and other forest produce. The forests examined were those of the Blue Nile, White Nile and lower Sobat, and Kordofan, but though these are no doubt the most important, many others remain unvisited. The most valuable timber trees of the Sudan forests are those known as kakamut (*Acacia campylacantha*), sant (*A. Arabica*), and inderab (the large-leaved species, *Cordia abyssinica*). The last-named is light and easily worked, and is consequently of more general use than either of the other two, which, though very durable, are hard and heavy. Among other useful timbers, those known as "taraiya" and "heglik" (*Balanites ægyptiaca*) merit attention as supplying longer and straighter logs than many others; while "homeid" (*Sclerocarpa* sp.), though not durable, might serve as a substitute for common deal, which is at present imported in considerable quantities. The exploitation of the forests is at present carried out without system, and straight and well-grown trees are rare owing to the damage caused by fire and grazing. Mr. Muriel suggests various areas as suitable for the formation of timber reserves, the most important being on the Blue Nile. Small areas of good "sant" (the conservation of which is of special importance owing to the employment of the wood for railway sleepers) occur also on the White Nile. For fuel, of which the supply needed by the Government works alone would involve the felling of 4·8 square miles of forest annually, the formation of reserves to be cut on a regular rotation of from fifteen to twenty years is also recommended. Of other forest products, gum, produced chiefly by the "hashab" acacias of Kordofan, is the most important. During the Dervish occupation the gum trade ceased, and many of the "genenas" or plantations were cleared for *dukhn*. Many have since been reformed, and are again yielding gum, but a more systematic treatment is needed. Other forest products are fibres, tans, caoutchouc, gutta percha, etc.

Altitude of Lakes Tanganyika and Mweru.—In a note on the scientific results of the Lemaire expedition (*Journal*, vol. xvii. p. 659) we quoted the values obtained for the altitudes, among other places, of Lakes Tanganyika and Mweru. Captain Lemaire has since recalculated the results with the aid of barometric and thermometric observations taken at Dar-es-Salaam simultaneously with his observations in the centre of the continent, and has communicated the revised figures to the *Mouvement Géographique* for July 14 last. For Tanganyika he obtains altitudes varying within narrow limits, according to the four different *formulæ* employed in the calculation, the extremes being 2741 and 2759 feet. The result previously obtained, 2549 feet, is thus far too low, and this Captain Lemaire attributes to the use of the tables supplied by the late Captain Delporte. Barometric observations taken on the east and west coasts since the date of the compilation of the tables show, he thinks, that a correction of +167 feet must be made in the results obtained from these tables. This correction (combined with another of less importance) would give as the altitude of Tanganyika, 2744 feet—a figure closely agreeing with those mentioned above. Applying the same corrections in the case of Mweru, Captain Lemaire obtains a height of 3189 feet, while by the use of the *formulæ* of Babinet and Augot the figures are, respectively, 3181 and 3198 feet, so that here too there is a satisfactory agreement between the results. It may be noted that whereas this revision places Captain Lemaire's result for Tanganyika in close agreement with that of previous travellers (*e.g.* Stanley, 2756 feet), it increases the divergence in the case of Mweru. Previous observations here had, however been less numerous and trustworthy than those on Tanganyika.

The Rufiji Delta.—An account by Captain Prüssing, of the various channels which compose the Rufiji delta, appears in the second number of the *Mitteilungen aus den Deutschen Schutzgebieten* for the present year, accompanied by an excellent map by Herr Sprigade. Captain Prüssing, who speaks from personal knowledge gained during careful surveys, gives a detailed description, as regards depth, navigability, etc., of the separate arms of the river, of which the most important is that known as the Mto Suninga, which enters the sea by the Simba Uranga mouth. On this arm, the bar of which can always be crossed by ocean vessels at high water, lie the sawmills of the Rufiji Industries Company, and higher up the forest station of Salale. At both of these the river has a depth of 16 feet, so that the largest native craft can always take in cargoes. Like most of the delta arms, the Mto Suninga becomes very shallow at a distance from the sea, and there is no possibility of continuous navigation to the upper Rufiji. There are loading-places for wood on other arms, and much of the land is said to be very suitable for rice growing. Buoys have been placed in several of the mouths to facilitate navigation, but owing to the shifting nature of the channels, constant surveys, and occasional rearrangement of the buoys, will be necessary.

The Etinde Volcano, Kamerun.—Dr. Esch, of Berlin, who has lately made a careful study of the Etinde volcano in the Kamerun territory, gives the results of his investigations in the *Sitzungsberichte* of the Prussian Academy of Sciences (1901, part xii.). The volcano, though quite independent of the better known Kamerun peak, has received little attention at the hands of travellers, but it offers many points of interest to scientific geographers. Its summit lies almost exactly on the line of volcanic activity running from the Kamerun peak, through Clarence peak on Fernando Po, and the eruptive centres of the islands of Principe, São Thome, and Annobon. At a distance of only 3 miles from the coast it rises, at an elevation of some 3500 feet, from the broad platform of the Kamerun peak, its summit reaching a height of 6500 feet above the sea. Its slopes, which fall almost precipitously towards the sea, are free from the lavas, ashes, and tuffs which cover the base of its larger neighbour, and whereas this latter, with its subsidiary cones, shows little traces of modification of form by erosion, Etinde is cut up by deep ravines forming steep narrow ridges, which would be inaccessible were it not for the thick bush which covers them. This fact had previously stood in the way of the ascent of the peak, which was accomplished for the first time by Dr. Esch. Although its age cannot be determined with certainty, there is no doubt that it represents one of the oldest outbursts in the district. It differs equally in the composition of its rocks from the neighbouring Kamerun peak, for whereas this presents only basalts and andesite, Etinde consists only of leucite and allied rocks, in which felspar is altogether wanting. The petrographical character of these rocks forms the subject of the greater part of Dr. Esch's paper.

AMERICA.

Nicholas Garry's Journeys in Canada, 1821.—A hitherto unpublished diary, kept by Nicholas Garry of the Hudson's Bay Company during his visit to the interior settlements in 1821, has lately been printed in the *Transactions* of the Royal Society of Canada (vol. vi. sect. 2). The journey it describes was undertaken on the amalgamation of the Hudson's Bay and North-West Companies, it being thought desirable that the settlements should be visited by representatives of both companies for the purpose of giving effect to the arrangements necessitated by their union. The diary was kept from day to day during the journey, and is of much interest from the vivid picture

it presents of the dangers and hardships involved by such a journey in the early days of Canadian settlement, as well as from the valuable information it supplies as to the state of affairs in the far interior at a critical period in Canadian history. The voyage was made by the frail birch-bark canoes which then formed the only means of communication with the distant settlements, and led by the usual route *viâ* the Ottawa and the upper lakes to the Red river settlement, and thence by Lake Winnipeg to Fort York, near the mouth of the Nelson river. Nicholas Garry, from whom the well-known Fort Garry in the Red river district took its name, and who was deputy-governor of the Hudson's Bay Company from 1822 to 1835, describes his experiences in a straightforward and unassuming style, and shows himself to have been actuated by a sincere desire to carry out his commission in a way which should further the best interests both of the Company and its employés and of the settlers in those remote regions. He seems to have been a shrewd observer, and his journal abounds with interesting accounts of the scenery and natural productions of the regions passed through, the habits and methods of the hardy Canadian voyageurs, and the general state of the country at the time. We learn that the settlement of Canada proper ceased at that time a little beyond the Lac des Alumettes on the Ottawa river, no cultivated ground being seen beyond this point except in the vicinity of the trading ports. The fortunes of the Red river settlement were then by no means promising, the colonists being exposed to hardships of all kinds. The agricultural capabilities of the country were, however, fully recognized by Garry, who speaks of the excellence of the fine black soil and the verdure and luxuriance of the grass. From Fort York, whence a visit was paid to the Nelson river to test its capabilities for anchorage as well as the suitability of its shores for the site of a fort, Garry returned to England by sea, the passage of Hudson strait occupying seventeen days. The diary has been communicated to the Royal Society of Canada by Canon Garry, son of the writer, whose grandson, Mr. Francis Garry, has carried out the difficult work of transcription, besides elucidating the text by valuable notes.

Urban Population of the United States.—A recently issued bulletin (No. 70) on the twelfth census of the United States, discusses the position of the urban population of that country in 1900 as compared with previous censuses, particularly those of 1880 and 1890. Tables are given showing in detail the facts at the different censuses grouped in a variety of ways, but it is only to the wider aspects of distribution brought out by these tables that reference can be made here. For purposes of comparison with earlier censuses the lower limit of town population is taken arbitrarily at the comparatively high figure of 8000, but figures are also given in some cases on the basis of a limit of 4000, which is in many ways more consistent with the natural division between town and rural population. On the former basis it is found that the urban population of the United States reached a total of 25,000,000 in 1900 as compared with a total of very nearly 18,300,000 in 1890, giving a percentage to total population of 32·9 as compared with one of 29 in 1890. Excluding the population of Indian territory and reservations, and of Hawaii, these percentages stand at 33·1 and 29·2 respectively. Between 1790 and 1900 the proportion of urban to total population has steadily risen from 3·4 to 33·1 per cent., the increase during the past half-century having been from 12·5 to 33·1. Taking the lower limit, there were in 1900 28,411,698 persons living in 1158 incorporated places and New England "towns" of 4000 inhabitants and over, and constituting 37·3 of the total population of the country. The proportion of urban population naturally differs immensely in the different geographical divisions of the United States. In the North Atlantic division it reached in 1900 the high figure of 64·7 per cent., as compared with 35·5 and 35·9 per cent. in the

North Central and Western divisions respectively, and 19·6 and 13·5 in the South Atlantic and South Central divisions respectively. There are nine individual states in which the urban population ranged in 1900 from not quite one-half to over nine-tenths of their total population, and 19 states and territories in which the proportion was less than one-sixth. The *increase* during the decade in the urban population is, as might be expected, greatest in the more newly settled portions of the whole area, reaching 41·9 per cent. in the western division as compared with 35·2 per cent. in the North Atlantic and 31·9 in the South Atlantic division. The most significant growth of cities in the whole country is that for the three cities in the state of Washington—Seattle, Spokane, and Tacoma—which in 1880 had together a population of only 4981, but which had in 1890 a combined population of 98,765, and in 1900, one of 155,233, the increase during the last decade being 57·2 per cent.

AUSTRALASIA AND PACIFIC ISLANDS.

Captain Cook in New South Wales.—Mr. James Bonwick has printed a brochure on the subject of the naming of Botany bay and New South Wales as recorded in the official narrative of Cook's first voyage and in other narratives, which, though undoubtedly authentic and original, differ in a surprising way from the first-named. This, as is well known, was compiled under instructions from the Admiralty by Dr. Hawkesworth, who, however, gave no clear indication of the sources from which he drew his information. Mr. Bonwick holds that Hawkesworth had access to no original account of the voyage of the *Endeavour*, those now available having, in his opinion, never passed through the compiler's hands. Of these original logs the most important are (1) that in Cook's own hand now in the British Museum; (2) the copy, also in the Museum, to which it was presented by Sir Joseph Banks; (3) another copy signed by Cook and presented by him to his old commander, Sir Hugh Palliser. There are also various logs kept by officers of the ship, which were discovered, about a hundred years after the date of the voyage, behind some wainscotting at the Deptford victualling yard. Neither Cook's own logs nor these Deptford logs make any mention of Botany Bay or New South Wales, names which appear, as if bestowed by Cook during the voyage, in the official version by Hawkesworth. Several other logs, however, have spaces filled up, apparently in this country, with these and other names, in a handwriting differing from that of the bulk of the narratives. Among these Mr. Bonwick classes the copies of Cook's journal, one of which, generally known as Corner's, was used by Admiral Wharton when printing the journal for the first time in 1893. Mr. Bonwick casts doubts on the genuineness of this journal, although from the presence of a marginal note in Cook's own handwriting, he is forced to allow that it passed through Cook's hand. As to the reason for the change of the name originally bestowed by Cook (Stingray bay) to Botany bay, he has only some rather vague suggestions to make, one being that the "Dauphin map" of 1542, with its "Baie des Plantes," had come to light in the interval, and that the object was to revive the ancient name. He thus takes for granted the exceedingly doubtful proposition that the coast shown on the old Dieppe maps really represents the eastern coast of Australia.

Visit to Bougainville Island.—A recent number of *Globus* (vol. lxxx. No. 4) contains a short note on a visit to Bougainville island, carried out by a missionary settled in the adjoining Shortland group (Poporag of the natives). The Catholic missionaries who have established themselves here have succeeded in reaching the villages placed on the interior mountains of Bougainville, and to establish friendly relations with the inhabitants, though these were at first

exceedingly shy. The villages are placed on spurs or crests of the mountains, so that the people can watch all the paths by which they are approached. Watchmen are also placed in the highest trees, usually old bread-fruit trees, who keep watch over the coast lands, the dwellers in which are hostile to the mountaineers. On the north-east coast pile-dwellings were seen, but huts on the south-west coast were all placed on the level ground. The various tribes live in great isolation, and it is therefore not surprising to find a great variety of languages, thirty of which, too divergent to be termed dialects, are estimated by the missionaries to be in use on the island. Polygamy is prevalent, but even the chiefs have rarely more than five wives. Cannibalism is restricted to about a third of the island, but human sacrifices, practised chiefly at the building of canoes or the death of a chief, prevail everywhere. Exception is taken to the inclusion of the Shortland islands in the British sphere by the latest Anglo-German agreement. The natives stand in close relations with those of the neighbouring coast of Bougainville, from which they obtain their wives; and any curtailment of intercourse would, it is said, lead to the extinction of the Shortland islanders.

POLAR REGIONS.

News of Peary.—The long-expected news of the doings, during the past two seasons, of the American Polar Expedition under Lieut. Peary, has at last come to hand. The steamer *Erik* which, as already announced in the *Journal*, sailed for the north from Sydney, Cape Breton, in July last, returned to the same port early in September, having been successful in opening up communication with the gallant explorer, and bringing home Mrs. Peary, who went out last year in the *Windward*. The work so far accomplished, though hardly realizing the expectation which had been formed as regards the advance northwards, is valuable from a geographical point of view as bringing to light for the first time the configuration of the whole northern coast of Greenland, on which Lieut. Peary has reached a more northerly point than had hitherto been attained. According to the scanty accounts yet published in the newspapers, the *Windward* was imprisoned in the ice at Payer harbour, in the vicinity of Cape Sabine, and there remained for eight months. Peary arrived on June 6 of this year, having wintered in the far north. He had started from Etah on April 15, 1900, with Henson and five Eskimo, and on May 8 reached the most northerly point attained by Lieut. Lockwood during the Greely Expedition, which is now, according to the newspaper reports, placed in 83° 30′ 25″, instead of 83° 24′ as originally given. Following the coast to 83° 39′, Peary found that it suddenly curved eastward. He therefore struck north towards the pole, but, having advanced over a disintegrated pack to 83° 50′, the highest latitude yet reached in the western hemisphere, was here stopped by open water. Returning southward, he continued his march eastward along the Greenland coast, until in 83° N., 25° W., he recognized the bold headland adjoining Independence bay, discovered by him in 1891. On June 15 he arrived at Fort Conger, having completed an accurate chart of the northern coast of Greenland, which in the part newly explored, is said to resemble Grinnell land, and to be evidently the littoral of the true arctic basin. Another attempted march towards the pole had to be abandoned, as neither men nor dogs proved in condition for the work. Peary has decided, however, to spend another winter in the north, and hopes to undertake a fresh expedition in the spring of next year.

The Baldwin Arctic Expedition.—A telegram was received on August 29 by the American Consul at Christiania, stating that the *Frithjof*, one of the vessels employed for the transport of the Baldwin Arctic Expedition to Franz Josef

Land, had returned to Hammerfest after safely landing the stores of the expedition at Cape Ziegler, in 80° 24′ N., 55° 52′ E. All the members of the expedition were stated to be in good health, and the dogs and ponies in good condition. The voyage to Cape Ziegler had occupied a month, and when the *Frithjof* sailed, the conditions were favourable for an advance northward, which Prof. Baldwin proposed to commence on the following day. It was reported at Hammerfest that several new islands had been discovered during the voyage to Franz Josef Land.

The Swedish Antarctic Expedition.—Information was received from Dr. Otto Nordenskiöld early in September to the effect that the sailing of the Swedish Antarctic Expedition had been provisionally fixed for the end of the month, by which time it was expected that the *Antarctic*, in which the voyage is to be made, and which has already acquired celebrity in connection with former Swedish, Norwegian, and Danish expeditions, would have returned from Spitsbergen, whither it proceeded early in the summer with the Swedish party for the measurement of an arc of the meridian. The leader of the expedition, Dr. Otto Nordenskiöld, will take charge of the geographical and geological work, and the other scientific members of the staff are: Dr. A. Ohlin and Mr. K. Anderson, zoologists; Mr. C. Skottsberg, botanist; Dr. G. Bodman, magnetician and hydrographer; and Dr. E. Ekelöf, medical officer and bacteriologist. An artist will probably also take part in the expedition, and an additional scientist will leave Sweden for the winter campaign of the ship. The command of the latter is entrusted to Captain C. A. Larsen, already well known for the part he has played in antarctic voyages. From Sweden the *Antarctic* will proceed direct to Buenos Aires, and thence by Staten island (where the instruments will be compared with those of the Argentine scientific station) to the South Shetlands and the east coast of Graham Land (King Oscar Land). Hence it is proposed to attempt an advance southward by the route described by Sir Clements Markham in the July number of the *Journal* as the "fifth route." The first task to be undertaken will therefore be to determine whether Graham land is an island or part of an extensive continent. In the latter case it might perhaps be possible to advance for a considerable distance by this route. In any case, if a suitable spot for the winter quarters can be found here, a station will be established for six or seven persons, under the command of Dr. Nordenskiöld himself, and observations carried out in harmony with those of the British and German expeditions. In case, however, no suitable quarters can be found, it will be necessary to plant the station somewhat further north, possibly in the neighbourhood of Cape Seymour. The ship, with two or three members of the scientific staff, will make the best use possible of the antarctic summer, and will then return to South America and the Falkland islands, where it will remain for the winter, the principal attention being devoted to biological work. On the approach of spring a course will be laid for the south, and work will be continued in the neighbourhood of the South Shetlands and along the ice-barrier, until it is found possible to push on to the winter station. It will then depend on circumstances whether the united expedition will make an attempt to examine carefully the route followed by Weddell in 1823, a factor in the case being the proposed co-operation, during the summer, with the Scottish expedition under Mr. Bruce. But in any case, the return to Sweden must be fixed for the end of the summer of 1902–3.

GENERAL.

The Oxford School of Geography.—To a syllabus just issued of the regulations in force at the Oxford School of Geography is appended a reprint of the examination papers set this year for the diploma in geography, which was awarded

to four candidates. It is satisfactory to note that a fairly high standard of knowledge is required of the candidates, the questions being often of a decidedly searching character, demanding a thorough grasp of the principles of the science. Papers were set in seven subdivisions of the subject, grouped in two main classes. Those in the first of these, viz. general physical geography and regional geography, are obligatory, while three papers only of the second group are to be selected by the candidates. Seven sub-headings of this group are defined, but papers were set this year in five only, the remaining two, ancient historical geography and military geography, being taken up by none of the candidates. Under the head of regional geography are included, in addition to some knowledge respecting the physical regions of the world and the distribution of plants and animals, "the chief facts of modern political and economic geography considered in relation to the influence of physical features." It thus covers a wide ground, which might perhaps be thought of too much importance to be dealt with in a single paper. The subjects of the second group are in part extensions of the general physical geography dealt with in the first group (*e.g.* geology, climatology, geomorphology) treated more in detail, and in part more special subjects, such as the history of geography and the principles of surveying and cartography. Inquiries with reference to the school are to be addressed to Mr. H. J. Mackinder, School of Geography, Old Ashmolean Building, Broad Street, Oxford.

OBITUARY.

Baron Nordenskiöld.

GEOGRAPHICAL science has sustained a severe loss by the death, which occurred on August 12, of Baron A. E. Nordenskiöld, the distinguished arctic explorer and authority on early cartography. Few geographers of our own day have combined, to so high a degree, a thorough scientific training with the work of an explorer in the field, and it would be difficult to name a contemporary who could be said to surpass, perhaps even to equal, the deceased Swedish *savant* in his wide grasp of the various branches of the science to which the best years of his life were devoted.

Adolf Erik Nordenskiöld was born at Helsingfors, in Finland, on November 18, 1832, and though during the greater part of his career his home was in Sweden, he retained throughout a warm interest in the affairs of his native land, which has so long been intimately connected with its southern neighbour by family and other ties. His ancestors came originally from Sweden, but had for some generations been settled in Finland, where his great-great-grandfather, Johan Erik Nordenberg, was superintendent of the saltpetre manufactories at Nyland. Various members of the family were noted for their devotion to scientific pursuits, not the least distinguished being Nils Gustav, the father of the deceased explorer, who early acquired a reputation as a mineralogist, and in 1824 became head of the Mining Office in Finland. To his influence, therefore, may be ascribed the early direction of the mind of the son towards those geological studies by which the groundwork was laid of his future high qualifications as a scientific explorer. Nordenskiöld entered the University of Helsingfors in 1849, and devoted especial attention to chemical and mineralogical work, which he likewise prosecuted during excursions in the vacations, and especially during a visit to the Urals, which he undertook with his father in 1853. He had already obtained appointments, with small salaries, both at the University and the Mining Office,

when he had the misfortune to arouse the suspicion of the Russian authorities through a supposed political allusion in an after-dinner speech. This cost him his appointments, but did not immediately result in the change of domicile which had so important an effect on his subsequent career. After working for a time in Berlin, he returned to Finland, where he obtained the Alexander travelling stipend at Helsingfors University, having formed a plan for geological research in Siberia and Kamchatka. But at a congregation at the University, at which he was to take his Doctor's degree before setting out on his travels, an incident took

BARON ADOLF ERIK NORDENSKIÖLD.

place by which he again fell under the displeasure of the authorities, and was finally forced to leave the country. He settled at Stockholm during the winter of 1857–58, and though the prohibition to visit Finland was subsequently withdrawn, Sweden became thenceforth his adopted country.

It was in the spring of 1858 that Nordenskiöld received an offer to take part as geologist in the first expedition to Spitsbergen, led by the Swedish geologist Otto Torell, whose death preceded by less than a year that of his distinguished associate. This was the beginning of a long period of useful work in the arctic regions, which

perhaps did more than anything within the same period to revolutionize our knowledge of those northern parts of the world. At the time of Torell's first voyage, Spitsbergen, though its coasts had been known for more than two centuries and a half, had never been scientifically explored, and the knowledge possessed, not only of its geology, but even of the topography of its interior, was of the most meagre kind. Torell's attention had been directed to it by his research on glacial phenomena, for the prosecution of which it was necessary to obtain more accurate knowledge of the conditions still prevailing in the far north. Valuable observations were made during the voyage, an important result being the discovery, by Nordenskiöld, at Bell sound, of remains of tertiary plants, which with others found by subsequent expeditions have led to such important conclusions respecting the climates which prevailed in former epochs. The expedition returned during the same year, and before its close Nordenskiöld received the important appointment of Professor and Curator of the mineralogical department of the Swedish "Riks-museum." During his long tenure of this office it was his constant endeavour to add to the extensive collections at the museum both by purchase and by private efforts.

In 1861 Nordenskiöld took part in Torell's second Spitsbergen expedition, which had still more important results as regards the geological history of that region, the whole northern part of the island group being for the first time carefully examined from this point of view. The expedition had been partly organized with a view to testing the practicability of the measurement of an arc of the meridian, as suggested by the President of the Royal Society of London. A beginning towards this important operation was made by the study of the ground for the necessary triangulation in the northern part of the main island.

In July, 1863, Nordenskiöld married Anna, daughter of Count Karl Mannerheim, a Finnish lady, to whom he had betrothed himself during a visit in 1862 to his native land. Further arctic exploration seemed removed from his future sphere of labour, when in 1864 he was asked by the Swedish Academy to take command, in the place of Dr. K. Chydenius, of a new expedition for the continuance of the work in connection with the proposed degree-measurement. During this expedition, in which he was accompanied by Dunér and Malmgren, the southern part of Spitsbergen was mapped, and valuable botanical and zoological investigations carried out. An attempt to reach a high northern latitude was made in the autumn of that year, but, in spite of the fact that the water was unusually open, was frustrated by the necessity of rescuing a party of shipwrecked walrus-hunters. The hope of accomplishing something in this direction was not, however, abandoned, and after an interval of three years Nordenskiöld succeeded in obtaining the despatch of a well-organized expedition, supported by the Swedish Government as well as by private patrons, among whom Oscar Dickson, the future munificent supporter of so many arctic ventures, was included. The iron steamer *Sofia* was placed at the professor's disposal, and in it he accomplished a successful voyage, reaching, in lat. 81° 42′ N., a higher northern latitude than is known to have been attained, down to that date, in the eastern hemisphere.

By this time the exploration of the arctic regions had become an absorbing object on the part of Nordenskiöld, who continued to devote his best energies to its attainment. An offer by Mr. Oscar Dickson to contribute to the despatch of a new expedition was joyfully accepted, and a trip was undertaken in 1870 to Greenland for the purpose of studying the applicability of dogs for sledge journeys, it being proposed to attempt such a journey northwards from the north of Spitsbergen. In itself, however, the visit led to valuable scientific results. In particular, an examination of the geological structure of the country was for the

first time made, and the vast inland ice-sheet of Greenland first trodden by a scientific observer. To Dr. Berggren, his companion, was due the important discovery of a scanty vegetation of *algæ* covering the ice-sheet. The main expedition did not start until 1872, and, owing to unforeseen circumstances, was not so successful as had been hoped. The two tenders were caught in the ice, and the crews of three vessels were thus unexpectedly forced to winter in Spitsbergen, involving an insufficiency of provisions. Valuable researches on the aurora and its spectrum, on the development of vegetation during the winter, and on the arctic flora of past epochs, with complete magnetic and meteorological observations, were however made. Undeterred by the experiences of 1872–73, Mr. Dickson resolved to continue operations, and in 1875 work was commenced in a new field by a voyage, in a sailing vessel, to the mouth of the Yenesei, which river was ascended to Yeneseisk. The voyage attracted special attention from the possibility which seemed opened of the inauguration of a commercial sea-route from Europe to Northern Asia, towards which such persevering efforts were put forth, both before and since, by our countryman, Captain Wiggins. Further voyages were made in the following year, and, besides resulting in the usual rich harvest of scientific results, led indirectly to the inception of the most important undertaking with which Nordenskiöld's name is associated, and in which the "north-east passage" round the northern shores of Europe and Asia, so long a desideratum on the part of navigators, was at last successfully accomplished.

Into the details of the memorable voyage of the *Vega*, the main outlines of which are familiar to all interested in polar voyages, we cannot enter here. The *Vega*, under the naval command of Lieut. Palander, left Karlskrona on June 22, 1878, doubled Cape Cheluiskin, the most northern point of the Old World, in the following August, and, after approaching within 100 miles of Bering strait, was finally frozen in at the end of September, and thus forced to winter in the arctic, the voyage being successfully continued on the approach of the following summer. The record of the expedition, in which, under the title 'The Voyage of the *Vega*,' an excellent account was given to the public, both of the events of the voyage and the main scientific results, is probably the most widely known of Nordenskiöld's writings. The full record of the scientific observations, which were among the most valuable ever brought home by an arctic expedition, were afterwards published in Sweden in five bulky volumes.

Nordenskiöld's last arctic expedition was that to Greenland in 1883, during which a successful attempt was made to penetrate the interior over the vast inland ice-sheet. Its chief result was to negative the idea, which had been entertained by the explorer, that a region free from ice might possibly exist in the centre of the country, but valuable information as to the structure and nature of the ice-sheet was also obtained. During the latter years of his life, Nordenskiöld paid much attention to the early history of cartography, and his two monumental works, indispensable to every student of that subject, are too well known to need description here. The second of these, on which the title 'Periplus' was bestowed, opened up a practically new field of research in relation to the early charts and sailing directions in use among European navigators.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By EDWARD HEAWOOD, M.A., *Librarian*, R.G.S.

THE following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full :—

A. = Academy, Academie, Akademie.
Abh. = Abhandlungen.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Com. = Commerce.
C. Rd. = Comptes Rendus.
Erdk. = Erdkunde.
G. = Geography, Geographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
k. u. k. = kaiserlich und königlich.
M. = Mitteilungen.
Mag. = Magazine.
Mem. = Memoirs, Mémoires.
Met. = Meteorological.
P. = Proceedings.
R. = Royal.
Rev. = Review, Revue.
S. = Society, Société, Selskab.
Sitzb. = Sitzungsbericht.
T. = Transactions.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Alps. *B.S G. Lyon* **17** (1901): 205–214. **Perreau.**

Le Grand Saint-Bernard et Napoléon. Par Capitaine Perreau.

Alps—Subdivisions. *M. Deutsch u. Oesterreich. Alpenv.* (1901): 93–98. **Gerbers.**

Uebersichtliche Eintheilung der Ostalpen. Von Hugo Gerbers.

Austria-Hungary. *M. Militär-G.I.* **20** (1900): 96–121. ——

Die Fortsetzung des Präcisions-Nivellements, ausgeführt im Jahre 1900.

Denmark—Meteorology. ——

Nautical-Meteorological Annual, 1900. Published by the Danish Meteorological Institute. Kjøbenhavn: G. E. C. Gad, 1901. Size 12½ × 9½, pp. xxviii. and 202. *Maps and Diagrams. Presented by the Danish Meteorological Institute.*

France. *B.G. Hist. et Descriptive* (1900): 237–262. **Fournier.**

Les chemins de transhumance en Provence et en Dauphiné (xviii^e. siècle). Par M. J. Fournier.

On the routes followed in the annual migration of the flocks in search of pasture.

France. *A travers le Monde, Tour du Monde*, **7** (1901): 233–235. **Mauberger.**

Une ville morte en Saintonge. Une visite à Brouage. Par G. Mauberger. *With Illustrations.*

Three centuries ago Brouage was an important military and commercial centre, but is now a small town rarely visited by outsiders.

France. *B.S.G. Lyon* **17** (1901): 220–262. **Privat-Deschanel.**

Hydrologie et hydrographie beaujolaises. Par M. Paul Privat-Deschanel. *With Diagrams.*

A careful study of the hydrography, both above ground and subterranean, of the region between the Saône and the Loire.

France. *Ciel et Terre* **22** (1901): 1–6. **Rocquigny-Adanson.**

Époque de la floraison du Perce-neige dans le centre de la France. Par G. de Rocquigny-Adanson.

Observations on the date of flowering of the snowdrop have been made at the park of Baleine since 1857, with an interval of four years only. The earliest date recorded, in 1873, was January 5, but the total number of January records was only thirteen.

France—Auvergne. *C. Rd.* **133** (1901): 176–178. **Glangeaud.**

Formation de nappes de glace, en été, dans les volcans d'Auvergne. Par M. Ph. Glangeaud.

This is referred to in the Monthly Record for September (p. 307).

France—Gascony. *B.G. Hist. et Descriptive* (1900): 121–134. **Bladé.**

Géographie féodale des Comtés de Fézensac et d'Armagnac. Par M. J.-Fr. Bladé.

France—Isle of Aix. *B.G. Hist. et Descriptive* (1900): 174–176. **Pawlowski.**

Carte-plan de l'île d'Aix, dressée par Cornuau en 1672. Présentée avec une note explicative, par M. A. Pawlowski. *With Sketch-map.*

France—Lille. *B.G. Hist. et Descriptive* (1900): 355–430. **Quarré-Reybourbon.**

Plans anciens et modernes de la ville de Lille, suivis des cartes de la châtellenie de Lille. Par M. Quarré-Reybourbon.

France—Place-names. *B.G. Hist. et Descriptive* (1900): 92–120. **Loisne.**

Sur les formes originales des noms de lieux du Pas-de-Calais et leurs formes officielles. Par M. A. de Loisne.

France—Touraine. *B.G. Hist. et Descriptive* (1900): 210–236. **Chauvigné.**

Inventaire des cartes anciennes et modernes de Touraine. Par M. A. Chauvigné.

Germany—Frankfurt am Main. ———

Beiträge zur Statistik der Stadt Frankfurt am Main. N.F. Drittes Heft: Tabellarische Uebersichten, betreffend dem Civilstand der Stadt Frankfurt a. M. in den Jahren 1892 bis 1900 (pp. 18 and cclx.); Viertes Heft: Frankfurter Krankheitstafeln. Frankfurt a. M., 1900–1901. Size 11 × 7½, pp. 56 and lxxxii. *Diagrams.*

Germany—Prussia. **Ambrosius.**

Die Volksdichte am Deutschen Niederrhein. Von Dr. Ernst Ambrosius. (Forschungen zur deutschen Landes- und Volkskunde . . . herausgegeben von Dr. A. Kirchhoff. XIII. Band, Heft 3.) Stuttgart: J. Engelhorn, 1901. Size 9½ × 6½, pp. 157–267. *Maps.*

This is referred to in the Monthly Record (*ante*, p. 438).

ASIA.

Central Asia. **Bobrinsky.**

Ornament of the Tajiks of Darwaz (The Highlands of Bukhara). Central Asia. By Count A. Bobrinsky. [In Russian.] Moscow. 1900. Size 15 × 11½, pp. 18. *Plates. Presented by the Author.*

China. *National G. Mag.* **12** (1901): 266–272. **Barrett.**

China: Her History and Development. By John Barrett.

China. *B.S.G. Lille* **35** (1901): 397–410. **Leclère.**

Les ressources minérales des provinces chinoises voisines du Tonkin. Par A. Leclère.

China. *J.R. United Service I.* **45** (1901): 272–280, 435–446. **Matusovski.**

Information relating to the Chinese Empire. From the Russian of Lieut. Z. Matusovski. Translated by Lieut.-Colonel W. E. Gowan.

China—Manchuria. **Ilinski and Bretschneider.**

Notes on the Kwantung Territory in South Manchuria and the adjacent Islands leased by China to Russia. By Lieut.-Colonel Ilinski and Dr. E. Bretschneider. [In Russian.] St. Petersburg, 1900. Size 9½ × 6, pp. 26 and 28. *Map. Presented by Dr. E. Bretschneider.*

A reprint from the *Izvestiya* of the Russian Geographical Society.

China—Manchuria. *Scottish G. Mag.* **17** (1901): 303–310. **Ross.**

Trade-Routes in Manchuria. By Rev. John Ross.

China—Telegraph Cable. ———

Submarine Telegraph Contract (Chefoo and Wei-Hai-Wei). Copy of "Agreement made April 23, 1901, between His Majesty's Government and the Eastern Extension, Australasia, and China Telegraph Company, Ltd., for the provision

and working of a Submarine Cable between Chefoo and Wei-Hai-Wei, together with a copy of the Treasury Minute thereon, dated April 24, 1901." London: Eyre & Spottiswoode, 1901. Size 13 × 8½, pp. 8.

China and Tongking. *A travers le Monde, Tour du Monde* **7** (1901): 221–222. ——

Le chemin de fer de Haiphong à Yunnan-Sen. *With Map.*

Chinese Turkestan. **Stein.**

Note on Topographical Work in Chinese Turkestan. By Dr. M. A. Stein. (From the *Geographical Journal* for April, 1901.) Size 10 × 6½, pp. 6.

Eastern Asia. *Petermanns M.* **47** (1901): 140–142. **Futterer.**

Ueber Gestalt und Gliederung einer Grundlinie in der Morphologie Ostasiens. Nach F. v. Richthofen. Von K. Futterer.

A note on the original paper was given in the *Journal* for June (p. 658).

Eastern Asia. *Sitzb. K.P. Akad. Wissens. Berlin* (1901) xxxvi.: 782–808. **Richthofen.**

Geomorphologische Studien aus Ostasien. II. Gestalt und Gliederung der ostasiatischen Küstenbogen. Von Ferdinand von Richthofen. *Also separate copy, presented by the Author.*

French Indo-China. *B.G. Hist. et Descriptive* (1900): 284–322. **Durand.**

Les Moïs du So'n-Phòng. Par M. F.-M. Durand.

India—Andaman Islands. *Indian Antiquary* **30** (1901): 232–238. **Temple.**

An unpublished Eighteenth Century Document about the Andamans. By R. C. Temple.

Forms part of a manuscript in the India Office by Captain Ritchie, which also includes the description of the Nicobars already published in the same journal (cf. *G.J.*, vol. xvii. p. 550).

India—Assam. ——

Report on the Administration of the Province of Assam for the year 1899–1900. Shillong, 1901. Size 13½ × 8½, pp. xii., 178, and cccix. *Maps.*

India—Assam. ——

Report on Tea Culture in Assam for the year 1900. Shillong, 1901. Size 13 × 8½, pp. 4 and iv.

India—Bombay Observations. **Moos.**

Magnetical, Meteorological, and Seismological Observations made at the Government Observatory, Bombay, in the years 1898 and 1899, under the direction of N. A. F. Moos. With Appendices. Bombay, 1901. Size 14 × 10. *Diagrams. Presented by the Colaba Government Observatory, Bombay.*

India—Census. *J.R. Statistical S.* **64** (1901): 314–327. **Baines.**

The Indian Census. By J. A. Baines, C.S.I.

India—Punjab. ——

Report on the Administration of the Punjab and its Dependencies for 1899–1900. Lahore, 1901. Size 13½ × 8½, pp. xiv., 276, and ccxlviii. *Map and Diagram.*

India—Survey Report. ——

General Report on the Operations of the Survey of India Department, administered under the Government of India during 1899–1900. Prepared under the direction of Col. St. G. C. Gore. Calcutta, 1901. Size 13½ × 8½, pp. 110 and 30. *Maps and Plates. Presented by the Survey of India.*

This is noticed in the Monthly Record (*ante*, p. 439).

India—West Frontier. **Holdich.**

The Geography of the North-West Frontier of India. By Colonel Sir Thomas Holdich. (From the *Geographical Journal* for May, 1901.) Size 10 × 6½, pp. 18. *Map.*

India—Wrecks and Casualties. **Beaumont.**

Return of Wrecks and Casualties in Indian Waters for the year 1899, together with a chart showing the positions in which they occurred, and a diagram showing comparative numbers of the reported maritime casualties, etc., the total tonnage, and the number of lives lost, for the past twenty-three years. Prepared by Commander E. J. Beaumont. Calcutta, 1900. Size 13 × 8, pp. 72. *Presented by Commander Beaumont.*

AFRICA.

Abyssinia. **Wellby.**

'Twixt Sirdar and Menelik. An account of a year's Expedition from Zeila to Cairo through Unknown Abyssinia. By the late Captain M. S. Wellby. London and New York: Harper & Brothers, 1901. Size 9 × 6, pp. xxvi. and 410. *Maps and Illustrations.* ***Presented by the Publishers.***

This will be noticed elsewhere.

Central Africa. *Miss. Catholiques* **33** (1901): 275–276. **Vuillot.**

Carte des Missions Catholiques du Centre Africain. Par M. Paul Vuillot. *Map.*

The map embraces the zone between 2° N. and 20° S.

Congo State. **Levy.**

Im belgischen Congostaate. Streiflichter aus dem modernen Afrika. Von Victor Levy. Wien: L. Rosner, 1901. Size 9½ × 6, pp. viii. and 118. *Illustrations.* ***Presented by the Author.***

Written with a view to showing what the Belgians have accomplished on the Congo, and directing popular attention to a country of the capabilities of which the author has a high opinion. He professes to approach the subject entirely without bias.

Congo State—Lomami. *Mouvement G.* **18** (1901): 357–358. **[Wauters.]**

La Carte du Lomami. *With Map.*

M. Wauters publishes a new map embodying the results of recent journeys by agents of the Lomami Company.

Egypt. *Globus* **79** (1901): 375–379. **[Kelly.]**

Abseits vom Wege in Ägypten. Von R. T. K. *With Illustrations.*

Egyptian Sudan. **Austin.**

Survey of the Sobat Region. By Major H. H. Austin. (From the *Geographical Journal* for May, 1901.) Size 10 × 6½, pp. 18. *Map and Illustrations.*

Egyptian Sudan. *Globus* **79** (1901): 379–381. **Förster.**

Die neuesten Forschungen im Sobatgebiete. Von Brix Förster.

A note on this appeared in the last number of the *Journal*.

French Congo. *B.S.G. Lyon* **17** (1901): 270–281. ———

La région du Chari et la mission Gentil.

French West Africa. *Tour du Monde* **7** (1901): 193–288. **d'Ollone.**

La Mission Hostains-D'Ollone, de la Cote d'Ivoire au Soudan et à la Guinée. Par le Capitaine D'Ollone. *With Map and Illustrations.*

French West Africa. *Rev. G.* **49** (1901): 71–79. **Regelsperger.**

L'occupation des territories du Tchad; les missions Gentil et Joalland-Meynier. Par G. Regelsperger. *With Map.*

Kamerun. *Deutsch. Kolonialblatt* **12** (1901): 518–520. **Stein.**

Bericht über die Expedition des Freiherrn v. Stein.

On an expedition through the uninhabited zone north and north-west of the lower Sanga.

Kamerun. *Mouvement G.* **18** (1901): 307–309. **[Wauters.]**

Dans le Sud Kamerun. *Sketch-map.*

Short account of journeys by M. William (cf. *Journal*, vol. xvii. p. 431).

Madagascar. *Rev. G.* **48** (1901): 471–484; **49** (1901): 27–44. **François.**

L'Émyrne industrielle, agricole et commerciale. Par G. François.

Madagascar. *B.G. Hist. et Descriptive* (1900): 177–209. **Saint-Yves.**

Quelques documents sur Madagascar au XVII^e^ siècle (1667–1671). Par M. G. Saint-Yves.

Madagascar en 1767 et 1768, d'après les papiers du gouverneur Dumas. Par le même.

Madagascar. *A travers le Monde, Tour du Monde* **7** (1901): 185–188. ———

Le canal des Pangalanes. *With Map and Illustrations.*

See note in Monthly Record, p. 89, *ante*.

NORTH AMERICA.

Alaska—Cape Nome. *J. School G.* **5** (1901): 1–16. ———

Cape Nome, Alaska. *With Map and Illustrations.*

Canada. *Miss. Catholiques* **33** (1901): 224–226, 231–234, 246–249. **Grouard.**

Les Eldorados du Nord-Ouest Canadian. Excursion au Mackenzie et au Klondyke. Par Mgr. Grouard. *With Illustration.*

Canada—Newfoundland. *Quarterly Rev.* **194** (1901): 33–53. ———

The Newfoundland Question.

Mexico—Magnetic Observations. **Moreno y Anda.**

B. Observatorio Astron. Nac. Tacubaya **2** (1901): 216–294.

Resultados de las observaciones magnéticas practicadas en el Observatorio Astronómico Nacional de Tacubaya durante el año de 1896. Por M. Moreno y Anda.

Mexico—Oaxaca. *B. Observatorio Astron. Nac. Tacubaya* **2** (1901): 263–266. ———

Posición geográfica de la ciudad de Oaxaca.

Mexico—Tacubaya. **Moreno y Anda.**

B. Observatorio Astron. Nac. Tacubaya **2** (1901): 267–285.

Datos para contribuir al estudio climatológico del Valle de México. La variabilidad interdiurna media de la temperatura en Tacubaya. Por M. Moreno y Anda.

United States—Adirondacks. **Beaumont.**

Tour du Monde **7** (1901): 301–312.

Aux Lacs Français des Adirondacks (États-Unis d'Amérique). Par Gaston Du Boscq de Beaumont. *With Illustrations.*

United States—California. *J. School G.* **5** (1901): 16–24. **Dodge.**

The Big Trees of California. By Richard E. Dodge. *With Illustrations.*

A movement has been set on foot for the preservation of the big trees by Government.

United States—Coast and Geodetic Survey. ———

Report of the Superintendent of the Coast and Geodetic Survey, showing the progress of the work from July 1, 1898, to June 30, 1899. Washington, 1800. Size 11½ × 9½, pp. 964. *Maps and Plates. Presented by the Survey.*

CENTRAL AND SOUTH AMERICA.

Andes. *Globus* **79** (1901): 373–375. **Hauthal.**

Ein Profil der argentinisch-chilenischen Cordillere. Von Rudolf Hauthal.

Andes. *C. Rd.* **132** (1901): 1296–1298. **Lapparent.**

Sur l'érosión régressive dans la Chaîne des Andes. Note de M. de Lapparent.

Argentine Republic. **Bernárdez.**

Manuel Bernárdez. De Buenos Aires al Iguazú. Crónicas de un viaje periodistico à Corrientes y Misiones. Buenos Aires, 1901. Size 11 × 7½, pp. xii. and 128. *Map and Illustrations. Presented by Dr. F. P. Moreno.*

A well-illustrated popular account of the route from Buenos Aires to the falls of the Iguazu, which the author holds to be the most wonderful natural phenomenon in the whole of America. The falls surpass Niagara in height by 40 feet in breadth by 2500 yards, and have the advantage also in their picturesque arrangement.

Argentine Republic. **Francisci.**

Argentina. Le Colonie Agricole nella Provincia di Cordoba. Rapporto del conte Odoardo Francisci. (B. Ministero Affari Esteri. Aprile, 1901.) Roma, 1901. Size 9 × 6½, pp. 30.

Argentine Republic. ———

Anuario de la Dirección General de Estadística, correspondiente al año 1899. Tomo II. Buenos Aires, 1900. Size 10½ × 7, pp. 484.

Bolivia—Meteorology. ———

Sociedad Geográfica de La Paz (Bolivia). Boletin del Observatorio Meteorológico. No. 4. Desde Agosto de 1899, hasta Marzo de 1901. La Paz, 1901. Size 8½ × 6, pp. 84.

Brazil. *American J. Sci.* **12** (1901): 18–32. **Derby.**
Manganese Ore Deposits of the Queluz (Lafayette) District, Minas Geraes, Brazil. By O. A. Derby.

British Guiana. **Cameron.**
British Guiana. Report for 1899–1900. Colonial Reports, Annual No. 318, 1901. Size 10 × 6, pp. 28. *Price* 2*d*.

British West Indies. *J.S. Arts* **49** (1901): 537–545. **Lubbock.**
The British West Indies. By Sir Nevile Lubbock, K.C.M.G.

AUSTRALASIA AND PACIFIC ISLANDS.

Australasia. **Coghlan.**
A Statistical Account of the Seven Colonies of Australasia, 1899–1900. By T. A. Coghlan. Sydney, 1900. Size 9 × 5½, pp. 836. *Map. Presented by the Agent-General for New South Wales.*

Australia—Directory. ———.
Supplement, 1900, Relating to the Australia Directory, vol. i., ninth Edition, 1897. Corrected to November 15, 1900. London: J. D. Potter, 1900. Size 9½ × 6, pp. 32. *Price* 6*d*. *Presented by the Hydrographer, Admiralty.*

Australia—Year-Book. ———.
The Year-book of Australia for 1901. London: Paul & Co. Size 9 × 5½, pp. 840. *Maps. Price* 10*s*. 6*d*. *Presented by the Agent-General for New South Wales.*

Caroline Islands. *Kolon. Z.* **2** (1901): 96–97, 122–125. **Pauli.**
Erlebnisse und Eindrücke des ersten deutschen Ansiedlers in Ponape. Von C. F. G. Pauli. *With Illustrations.*

Fiji. **Finucane.**
The Islands and People of Fiji. By Morgan I. Finucane. (Read before the Royal Geographical Society of Liverpool, March 21, 1901.) Size 8½ × 5½, pp. 24. *Presented by the Author.*

New Zealand. ———.
Statistics of the Colony of New Zealand for the year 1899. Wellington, 1900. Size 13 × 8½, pp. xvi. and 530.

POLAR REGIONS.

Antarctic—Belgian Expedition. **Arctowski.**
Aperçu sur les Observations Météorologiques de l'expédition Antarctique Belge. Par M. Henryk Arctowski. (Sonderabdruck aus den Verhandlungen des VII. Internationalen Geographen-Kongresses in Berlin, 1899.) Berlin, 1900. Size 10 × 6½, pp. 648–651.

Antarctic—Climate. *Petermanns M.* **47** (1901): 128–132. **Supan.**
Das antarktische Klima. Von A. Supan.

Antarctic—Meteorology. *J. School G.* **5** (1901): 161–170. **Hubbard.**
The Meteorological Conditions of the South Polar Regions. By George D. Hubbard.

Arctic. **Abruzzi.**
The Voyage of the *Polar Star*. By His Royal Highness the Duke of the Abruzzi. (From the *Pall Mall Magazine*, June, 1901, pp. 255–266.) Size 9½ × 6½. *Map and Illustrations.*

Arctic. **Cagni.**
The Voyage of the *Polar Star*. Nearest the Pole. Commander Cagni's own account of his hazardous Journey. (From the *Pall Mall Magazine*, July, 1901, pp. 399–416.) Size 9½ × 6½. *Map and Illustrations.*

MATHEMATICAL GEOGRAPHY.

Cartography. *M. Militär-G.I.* **20** (1900): 191–193. **Burian.**
Combinierter Umdruck einer Farbenkarte. Von Johann Burian. *With Map.*

Cartography. *M. Militär-G.I.* **20** (1900): 179–190. **Hübl.**
Beiträge zur Technik der Kartenerzeugung. IV. Die Aluminium-Druckplatte. Von Arthur Freiherrn von Hübl.

Cartography—Military Maps. **Heimbach and Hödlmoser.**
M. Militär-G.I. **20** (1900): 194–212.
Die Militär-Kartographie auf der Weltausstellung in Paris 1900, nach den Berichten von Wilhelm Heimbach und Carl Hödlmoser.

Cartography—Military Maps. *M. Militär-G.I.* **20** (1900): 122–157. **Steeb.**
Die Kriegskarten. Von Christian Ritter von Steeb. *With Maps.*

Compass Correction. **Johnson.**
Compass Correction. By Comr. H. M. W. P. Johnson. (Course of Papers, No. 71.) Shipmasters' Society, London. 1900. Size 8½ × 5½, pp. 35–46.

Geodesy. *M. Militär-G.I.* **20** (1900): 39–63. **Netuschill.**
Die astronomischen Gradmessungsarbeiten des k. u. k. militär-geographischen Institutes. Die Breiten- oder Polhöhen-Bestimmungen. Von Franz Netuschill.

Geodesy. *M. Militär-G.I.* **20** (1900): 64–95. **Weixler.**
Bearbeitung des trigonometrischen Gradmessungsnetzes für Zwecke der Landesvermessung. Von Adolf Weixler. *With Diagram.*

Map-Scales. *Petermanns M.* **47** (1901): 119–120. **Habenicht.**
Neue Methode zur Veranschaulichung der Kartenmassstäbe. Von H. Habenicht.
The writer illustrates the relation which exists between the scale of a map, the supposed height of the eye of the observer above the surface depicted, and its distance from the plane of projection.

Photographic Surveys. *M. Militär-G.I.* **20** (1900): 171–178. **Pichler.**
Die Thätigkeit der Photographie-Abtheilung in den letzten Jahren. Von Friedrich Pichler.

Survey. **Richardson.**
Survey.—Practical and Precise. By G. F. Richardson. Wellington, 1901. Size 8 × 5, pp. 4. *Presented by the Author.*
Urges the execution by New Zealand of a triangulation capable of being applied to the measurement of an arc of meridian.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Meteorology. **Berson and Baschin.**
Hauptfahrten Nr. 31. 16. Fahrt des Ballons "Phönix" (4. Frühfahrt) 9 Juni 1894. A. Fahrtbeschreibung, von A. Berson. B. Meteorologische Ergebnisse, von O. Baschin. (Sonder-Abdruck aus Wissenschaftliche Luftfahrten herausgegeben von Richard Assmann und Arthur Berson.) Braunschweig, 1900. Size 12½ × 9½, pp. 315–325. *Diagrams.*

Meteorology. **Berson and Baschin.**
Hauptfahrten Nr. 33, 34. Die Gleichzeitigen Fahrten vom 6 bis 7 Juli 1894. A. Fahrtbeschreibung, von A. Berson. B. Meteorologische Ergebnisse, von O. Baschin. (Sonder-Abdruck aus Wissenschaftliche Luftfahrten herausgegeben von Richard Assmann und Arthur Berson.) Braunschweig, 1900. Size 12½ × 9½, pp. 338–351. *Diagrams.*

Meteorology. *Climat* (1901): 84–87. **Durand-Gréville.**
The Prediction for a stated time of squalls and storms. By E. Durand-Gréville. *With Diagrams.*

Meteorology. **Gross and Baschin.**
Hauptfahrten Nr. 11. 5. Fahrt des Ballons "Humboldt" 19 April 1893. A. Fahrtbeschreibung von H. Gross. B. Meteorologische Ergebnisse, von O. Baschin. (Sonder-Abdruck aus Wissenschaftliche Luftfahrten herausgegeben von Richard Assmann und Arthur Berson.) Braunschweig, 1900. Size 12½ × 9½, pp. 113–129. *Diagrams and Illustrations.*

Meteorology. **Gross, Berson, and Baschin.**
Hauptfahrten Nr. 23. 11. Fahrt des Ballons "Phönix" (3. Fahrt mit Luftelektricitätsmessungen) 17 Februar 1894. A. Fahrtbeschreibung, von H. Gross. B. Meteorologische Ergebnisse von A. Berson. C. Die Luftelektrischen Messungen von O. Baschin. (Sonder-Abdruck aus Wissenschaftliche Luftfahrten herausgegeben von Richard Assmann und Arthur Berson.) Braunschweig, 1900. Size 12½ × 9½, pp. 236–255. *Diagrams.*

Meteorology—Auroras. *B.A.R. Sci. et Lettres Danemark* (1901): 115–118. **Paulsen.**

Communications préliminaires sur quelques travaux de la mission danoise à Utsjoki. Par Adam Paulsen.

On the observations of auroras in Northern Finland during the winter of 1900–1901.

Oceanography. *Petermanns M.* **47** (1901): 73–83, 97–106. **Hjort.**

Die Erste Nordmeerfahrt des norwegischen Fischereidampfers "Michael Sars" im Jahre 1900 unter Leitung von Johan Hjort. *With Maps, Profiles, and Illustrations.*

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Commerce. **Atkinson.**

"British Manufactures and the Policy of Unfettered Commerce," and "The Interdependence of Nations." By Edward Atkinson, LL.D. The former reprinted from the *Engineering Magazine*, April, 1901. Size 9½ × 6½, pp. 44.

The writer insists that in commercial matters the nations of the world have common interests, and deprecates the idea that a state of trade-war is the necessary result of modern competition.

Commerce. *Monthly Rev.* (1901): 68–85. **Bowles.**

The Rational Horizon of Falmouth. By G. Stewart Bowles.

The writer considers that the British Isles, by their geographical position, must always retain their importance as the chief centre of the world's trade. He says nothing of the enormous recent increase in the trade of Hamburg, Antwerp, and Rotterdam, nor does he show in what way the position of these ports is markedly less favourable than that of British ports.

Commerce. *Monthly Rev.* (1901): 50–67. **Taylor.**

A Century of Sea Commerce. By Benjamin Taylor.

Telegraph Cables. *Rev. G.* **49** (1901): 45–57. ———

La question des cables sous-marins. Par L. R. *With Map.*

On French cable projects.

BIOGRAPHY.

Carolus. **Conway.**

Joris Carolus, Discoverer of Edge Island. A forgotten Arctic Explorer. By Sir Martin Conway. (From the *Geographical Journal* for June, 1901.) Size 10 × 6½, pp. 10. *Charts.*

Garcie. *B.G. Hist. et Descriptive* (1900): 135–173. **Pawlowski.**

Les plus anciens hydrographes français.—Pierre Garcie, dit Ferrande, et ses imitateurs. Par M. A. Pawlowski.

The writer calls attention to a 'Petit Routier,' published anonymously before the well-known 'Grand Routier' of Garcie, but which he considers to be the work of the same author.

Hecquard. *B.G. Hist. et Descriptive* (1900): 278–283. **Cordier.**

Un précurseur: Hyacinthe Hecquard. Par M. H. Cordier.

Hecquard was commissioned in 1849 to explore the route from Grand Bassam to Segu and Timbuktu.

GENERAL.

Bibliography—Geology. ———

Geological Literature added to the Geological Society's Library during the year ended December 31, 1900. London: Geological Society, 1901. Size 9 × 5½, pp. 182. *Presented by the Geological Society.*

Congress. *Verh. Ges. Erdk. Berlin* **28** (1901): 295–325. **Kollm.**

Der XIII. Deutsche Geographentag in Breslau. Von Georg Kollm.

Educational. **Dodge.**

J. School G. **4** (1900): 121, 179, 212, 264, 295, 342; **5** (1901): 25, 95, 136, 172.

A School Course in Geography. By Richard E. Dodge.

Medical Geography.

Selections from Colonial Medical Reports for 1898 and 1899. Colonial Reports, Miscellaneous, No. 16, 1901. Size 9½ × 6, pp. 420. *Diagrams. Price* 1*s.* 10½*d.*

Orthography.

The Spelling of Native Geographical Names. Perth, 1901. Size 8½ × 5½, pp. 10.

Urges the advisability of the adoption of the R.G.S. system in Western Australia.

Place-names. *B.G. Hist. et Descriptive* (1900): 83-91. **Martonne.**

Sur la toponymie naturelle des régions de haute montagne, en particulier sur les Karpates méridionales. Par M. E. de Martonne.

See note in September number (*ante*, p. 316).

Year-Book. **Wagner.**

Geographisches Jahrbuch. XXIII. Band, 1900 . . . herausgegeben von Hermann Wagner. Zweite Hälfte. Gotha: Justus Perthes, 1901. Size 8½ × 6, pp. 173-488.

The second part of the volume for 1900 has been somewhat delayed through the difficulty of obtaining reports on certain of the countries of Europe. Through the death of Dr. H. Schlichter the literature on the British Isles has not been dealt with. In addition to the section treating of the geography of Europe, there is a useful summary, by Dr. Sophus Ruge, of recent literature on mediæval geography, and another by Dr. F. Toula of that on structural geology.

NEW MAPS.

By E. A. REEVES, *Map Curator*, R.G.S.

EUROPE.

England and Wales. **Ordnance Survey.**

Ordnance Survey of England and Wales: Revised sheets published by the Director-General of the Ordnance Survey, Southampton: from August 1 to 31, 1901.

1-inch:—

Printed in colours, 183, 185, 186, 187, 189, 190, 191. 1*s. each.*
Towns and country around, with roads printed in colour: Salisbury, 1*s.* 3*d.*

6-inch—County Maps:—

Bedfordshire, 33 N.E., S.E. **Cumberland,** 5 S.W., 10 S.W., 24 N.E. **Derbyshire,** 50 S.W., 53 N.W., N.E., S.W., 54 N.W., N.E., S.W. 55 S.W., 58 S.W. **Glamorganshire,** 38 S.W., 43 N.E., S.W., 47 N.E. **Monmouthshire,** 33 S.W., 37 N.E. **Northamptonshire,** 6 N.W., 8 S.W., 14 N.W., 15 N.E. (19 S.E. and 20 S.W.), 27 S.W., 34 N.W. **Nottinghamshire,** 37 N.E., 41 S.E., 44 N.E., 53 N.W. **Staffordshire,** 33 N.W., S.W., 34 S.W. **Wiltshire,** 38 N.E., S.W., 39 N.W., 40 N.W., 45 N.W., 51 N.E., 52 N.W., 53 N.W., 55 N.W., S.W., 58 S.E., 59 S.E., 60 S.W., 61 N.W., 64 N.E., 69 N.E., 70 N.W., N.E., S.W. 1*s. each.*

25-inch—County Maps:—

Bedfordshire, III. 8; IV. 14, 15; IX. 5. **Cardiganshire,** II. 2, 6. **Derbyshire,** LVII. 9, 10; LIX. 4; LX. 1, 4, 5, 9, 12; LXI. 1. **Dorsetshire,** I. 11, 12, 16; II. 13; IV. 1, 5, 10, 11. **Huntingdonshire** I. (11 and 7), 15; IV. 3, 7, 8, 11, 12, 16; V. 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16; IX. 1, 2, 3, 4, 5, 6, 8, 10, 11, 12, 14, 15, 16; XII. 7, 8, 10, 12, 14; XIII. 1, 3, 7, 9, 10, 11, 12, 14, 15; XVI. 3, 14, 16; XVII. 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13, 14, 15; XX. 3; XXI. 3, 5, 6, 8, 9, 12, 14, 15. **Merionethshire,** XXXVIII. 16; XXXIX. 13, 14; XLII. 8, 12, 16; XLIII. 4; XLVII. 4, 8, 12, 15; XLIX. 2, 6. **Monmouthshire,** VIII. 10, 13, 15; IX. 13; XI. 10, 11; XII. 16; XIV. 1, 2, 3, 6, 10; XVII. 16; XXII. 16; XXIII. 7, 15, 16; XXIV. 14; XXVII. 4, 7, 12; XXVIII. 3, 4, 5, 8, 10, 11; XXIX. 7, 8, 10, 12, 14, 15; XXXIII. 12, 15, 16; XXXIV. 7. **Montgomeryshire,** IX. 8, 12; X. 3, 6, 9, 10, 11, 13, 14, 15; XII. 13, 14, 16; XIIA. 16; XIII. 2, 3, 7, 8, 9, 10, 12, 14, 15; XIV. 4, 5, 7; XV. 1, 2, 3, 5, 6, 7; XVIII. 8, 12, 16; XIX. 4; XX. 1, 2, 6, 7; XXI. 1, 9; XXV. 4, 8, 12, 15; XXXII. 2. **Shropshire,** V. 11, 14, 16; VII. 16; XII. 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 13, 16; XIV. 4; XVIII. 7; XIX. 7; XXV. 3. **Staffordshire,** XXIX. 2; XXX. 2; XXXVI. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16;

XXXVII. 1, 5, 6, 8, 9, 10, 14, 16; XXXVIII. 1, 9, 14; XL. 9, 12; XLI. 9, 10; XLVII. 4; XLVIIA. 1. **Wiltshire,** LXII. 7, 8, 12; LXIII. 5, 9, 12, 15, 16; LXVI. 8, 12, 16; LXXI. 8; LXXII. 1, 4, 8, 10, 11, 12, 14, 15, 16; LXXIV. 2, 4; LXXV. 1; LXXVII. 1, 2, 3, 4, 5, 7, 11. *3s. each.*

4 miles to 1 inch:—

(9 and 10), 15 (engraved). *1s. 6d. each.*

This completes the publication of the 4-mile map of England and Wales.

County maps with roads printed in colour:—Bedfordshire, Cambridgeshire, Huntingdonshire, Northamptonshire, and Rutland; * Brecknockshire, Herefordshire, Montgomeryshire, and Radnorshire; Cheshire, Shropshire, Staffordshire, and Flintshire (Det.); Derbyshire, Nottinghamshire, and Leicestershire; Gloucestershire, Warwickshire, and Worcestershire; Lancashire; Buckinghamshire, Berkshire, Hertfordshire, Middlesex and London. *9d. each.*
(E. Stanford, London Agent.)

England and Wales. **Bartholomew.**

Reduced Ordnance Survey of England and Wales. Scale 1: 126,720 or 2 stat. miles to an inch. Sheet 32. Sussex: J. Bartholomew & Co., Edinburgh, 1901. *Price 2s. Presented by the Publisher.*

The area included in this sheet is from Redhill on the north to the coast on the south, and from about three miles west of Liphook on the west to a little beyond Pevensey on the east. As in the rest of the series, the relief is shown by a system of tinting and contours, in addition to which altitudes are also given in figures. Main roads are coloured brown, and water blue.

ASIA.

Yenisei River. **Vilkitzki.**

Atlas of the River Yenisei from its mouth to Yeniseisk, from surveys made by the expedition under the command of Lieut.-Col. Vilkitzki. Published at the Chief Hydrographic Department, Ministry of Marine, St. Petersburg, 1900. [In Russian.] *Presented by the Chief Hydrographic Department, St. Petersburg.*

Considerable interest has for years past been taken in the question of the possible commercial development of Central Siberia by means of its important waterways, and in particular by way of the Yenisei river. This interest is due in a great measure to the voyages of Captain Wiggins up this river *viâ* the northern shores of Europe, and has led to the Russian Government undertaking a thorough survey of the Yenisei, which was commenced in 1894 by the expedition under Colonel Vilkitzki, and the results of which are now well set forth in the excellent atlas just presented to this Society. The charts of which the atlas is composed are on the scale of 5 versts (3·31 stat. miles) to an inch, and show the whole course of the Yenisei from Golchika at its mouth to Yeniseisk. It consists altogether of nine sheets, some of which are double, and an index. Many soundings are laid down, and islands, sandbanks, and rocks are indicated, as well as the nature of the banks. Parts where the survey is incomplete are shown by a dotted line. In addition to the charts, there are five pages of letterpress, an interesting table giving the speed of the current of the river at different points, and other useful information.

AFRICA.

Congo Free State. **Lemaire.**

État Indépendant du Congo Mission scientifique du Ka-tanga. Lieut. Ch. Lemaire du 2e Regt. d'Artillerie, Chef de Mission, Mr. F. Michel, second de la mission. Mr. L. Questiaux, Prospector. Scale 1: 1,000,000 or 15·7 stat. miles to an inch. 2 sheets. Falk Fils, Bruxelles.

This map consists of two sections, the first of which shows the route and the results of the surveys of the Belgian expedition under the command of Lieut. Lemaire from August 5, 1898, to March 2, 1900; and the second, the journey undertaken between March 24 and July 3, 1900. During the first of these two journeys Lieut. Lemaire and his party travelled from Lake Tanganyika in a south-westerly and westerly direction *viâ* Lake Mweru, to the upper waters of the Kasai and Lake Dilolo, following a course slightly to the north of the watershed between the Congo and Zambezi. Considerable detailed information was gained respecting the direction of the tributary rivers and streams forming the upper waters of these two rivers, which will render it necessary to modify our previous ideas in some respects, and to correct the map of this region. The second map commences at Lake Mweru, and illustrates Lieut. Lemaire's expedition to Lake Tanganyika, and thence down the Lualaba and upper Congo to

Stanley Ville, in the neighbourhood of Stanley falls. The places where observations for longitude were taken are indicated, and the method employed stated, and by means of a special symbol, those places where no astronomical observations were taken are clearly distinguished. By a somewhat remarkable omission, there is, however, nothing to show where the latitude was observed, nor does the map state upon what the route survey depends, nor what instruments were employed upon it. Numerous altitudes are given in metres, but here again it is not stated how they were observed, notwithstanding the fact that there is a note pointing out that the altitudes laid down on the map are somewhat too low, and giving the corrections for seven important places. The map is clearly drawn, and printed in colours. No attempt has been made to incorporate the work of previous explorers.

AMERICA.

Haïti. **Tippenhauer.**

Topographische und geologische Karte des Morne de la Selle, der Cul-de-Sac-Ebene und des Salzseengebietes, Insel Haïti. Gezeichnet von L. Gentil Tippenhauer. Scale 1:100,000 or 1·5 stat. mile to an inch. *Petermanns Geographische Mitteilungen*, Jahrgang 1901, Taf. 13 und 14. Gotha: Justus Perthes. *Presented by the Publisher.*

United States. **U.S. Geological Survey.**

Geologic Atlas of the United States. Scale 1:125,000 or 1·8 stat. mile to an inch. Folios: Bristol, La Plata, Monterey, Menominee, Mother Lode District, Uvalde, Tintic, Colfax, Danville, Walsenburg, Huntington, Washington, Spanish Peaks. Department of the Interior, United States Geological Survey, Charles D. Walcott, Director, Washington, D.C. *Presented by the U.S. Geological Survey.*

As is the case with the other folios of the United States Geological Survey, each of the thirteen above-mentioned consist first of all of a few sheets of descriptive and explanatory text, and then of a "topographic sheet" of the area under consideration, giving only the topographical features and the more important names. After this follow several sheets showing the geological features by well-selected colours and symbols based upon the topographic sheet, and sheets of sections and diagrams. In addition to forming a part of a most important and extensive survey of the United States, each folio is complete in itself, and a careful perusal of any one of them, together with a comparison of the various sheets it contains, cannot fail to be extremely instructive to the student of geology and physical geography.

CHARTS.

Russian Charts. Chief Hydrographic Department, Ministry of Marine, St. Petersburg.

Charts and Plans published by the Chief Hydrographic Department, Ministry of Marine, St. Petersburg.

Black Sea and Sea of Azov.

No.

554. Plan of Odessa. Scale 420 feet to an inch. 1901.
563. Plan of Batum. Scale 280 feet to an inch. 1900.
1797. Coast of Crimea from Cape Khersonese to Cape Meganom. Scale 2 geo. miles to an inch. 1900.
1824. Black sea, east coast from Gelenjik to Psezuap. Scale 2 geo. miles to an inch. 1901.
556. Plan of Marinpol. Scale 1400 feet to an inch. 1901.

Arctic Ocean.

561. Murman coast, bay of Evanovski. Scale 1400 feet to an inch. 1901.
555. Plan of Bear island. Scale 8400 feet to an inch.

Gulf of Finland.

565. Plan of the harbour of Peterhof. Scale 63 feet to an inch. 1900.

North Pacific Ocean.

558. Entrance to River Amur. Scale 4·1 geo. miles to an inch. 1900.
564. Korea bay, entrance to the Yalu river. Scale 1 geo. mile to an inch. 1901.

U.S. Charts. **U.S. Hydrographic Office.**

Pilot Chart of the North Atlantic Ocean for August, and North Pacific Ocean for September, 1901. U.S. Hydrographic Office, Washington, D.C. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

N.-E. Africa and Arabia. **Naretti.**

Seventy Photographs of natives and scenery of N.-E. Africa and Arabia. By Sigr. L. Naretti, of Massawa, and G. P. Devey, Esq. *Presented by G. P. Devey, Esq.*

Mr. Devey has already added many photographs to the Society's collection, and these which he has recently presented are specially welcome. The following is a list of the subjects:—

(1–8) Massawa; (9) Group of women of various tribes of Eritrea; (10) Assab—group of Danakil men and women; (11) Assab—a Somali caravan; (12) Assab—natives in palm trees; (13) Abyssinian musicians; (14) Abyssinian woman carrying child; (15) Abyssinian women porters; (16) Abyssinian weaving-loom; (17) Group of the chiefs of Adua; (18) Adua—family of Bascia Gion; (19) Queen Taitu and King Menelik; (20) Maccala—funeral ceremony; (21) Troops entering the emperor's palace on the day of the Mascal; (22) Ras Mangashia presiding at a tribunal; (23) Ras Mangashia on horseback; (24) Son and nephew of Ras Mangashia; (25) Ras Mangashia's jester; (26) A country woman carrying child; (27) A girl; (28) An Axum nobleman; (29) An Amara family; (30) Graves of Italians at Coatit; (31) Sudanese women; (32) Shiek Aly Nurin, chief of the advance guard at the taking of Kassala; (33) Beduin from Habab; (34) Kamaran island—Lazaret, 1897; (35) Kamaran island—a hospital in building; (36) A runaway slave; (37–48) Views of Jedda; (49) *Albatros*, an Austrian man-of-war, in Jedda roads; (50) The Kaaba viewed from Mount Keyis; (51) El Haram, the holy place of Mekka; (52 and 53) Attending the prayer around the Kaaba; (54 and 55) Pilgrim's arrival at Mount Arafat; (56) The Muna side beyond Mekka; pilgrimage to Seyid Memuniyé 12 miles distant; (57) East side of Muna valley; (58) Mezdelfe pilgrims passing; (59) Another view of the Kaaba; (60) The Omra; (61) West side of Muna valley; (62) The town of Medina; (63 and 64) The prophet's tomb ("the garden of purity"); (65) Town of Tarif; (66) Rock near Mekka beneath which Mohammed would retire to meditate; (67) Tomb of Khadija, and other monuments; (68) Arafat on pilgrimage day, A.H. 1314 (1897); (69) Departure of Armenian travellers from Van, 1892; (70) Hamidiyyeh officers and their sons returning from Constantinople, 1893, near Bayazid.

Portuguese East Africa—Barue Country. **Arnold.**

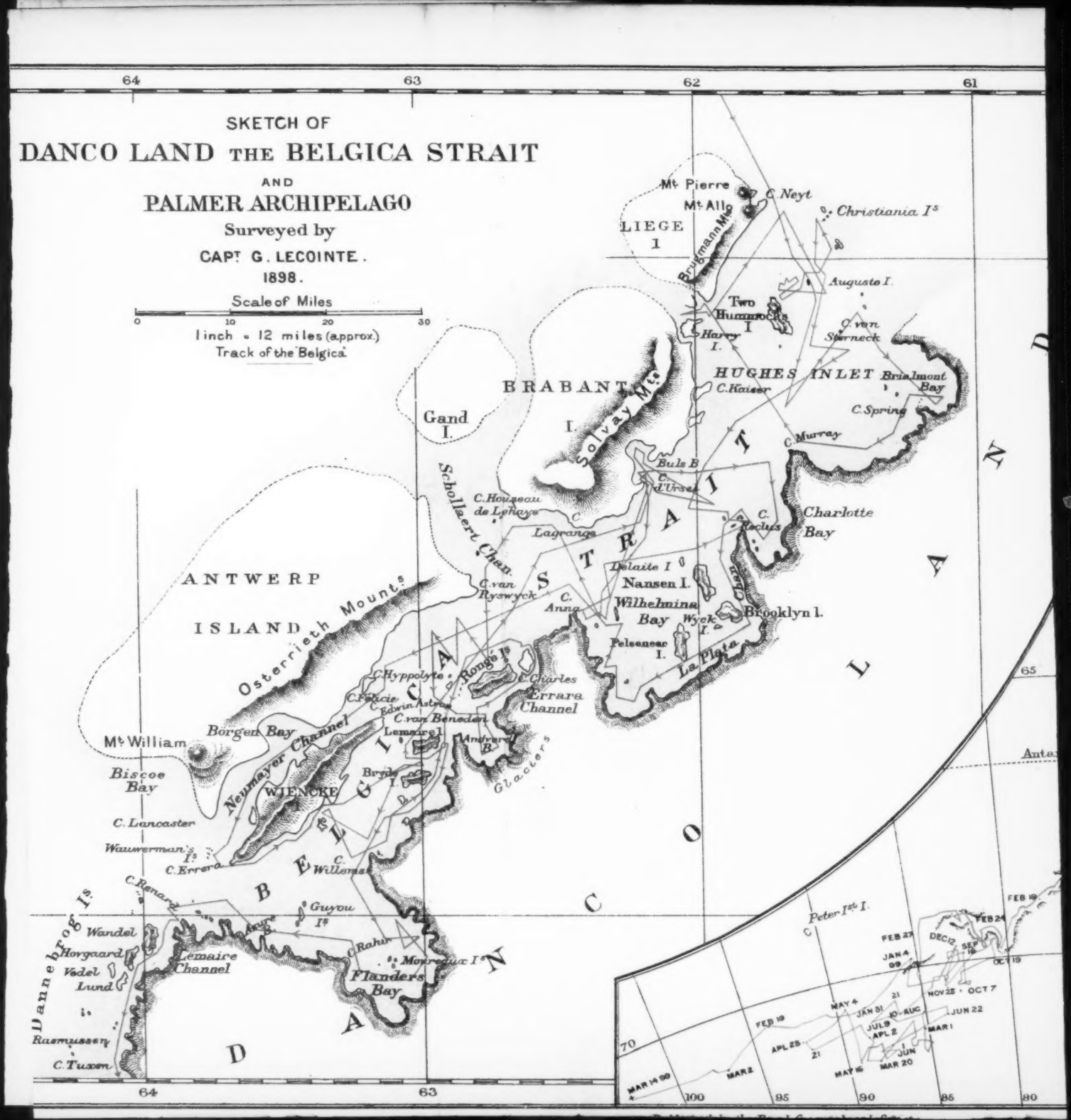
Thirty Photographs of the Barue Country. By Lieut.-Colonel A. J. Arnold, D.S.O., 1900. *Presented by Lieut.-Colonel Arnold.*

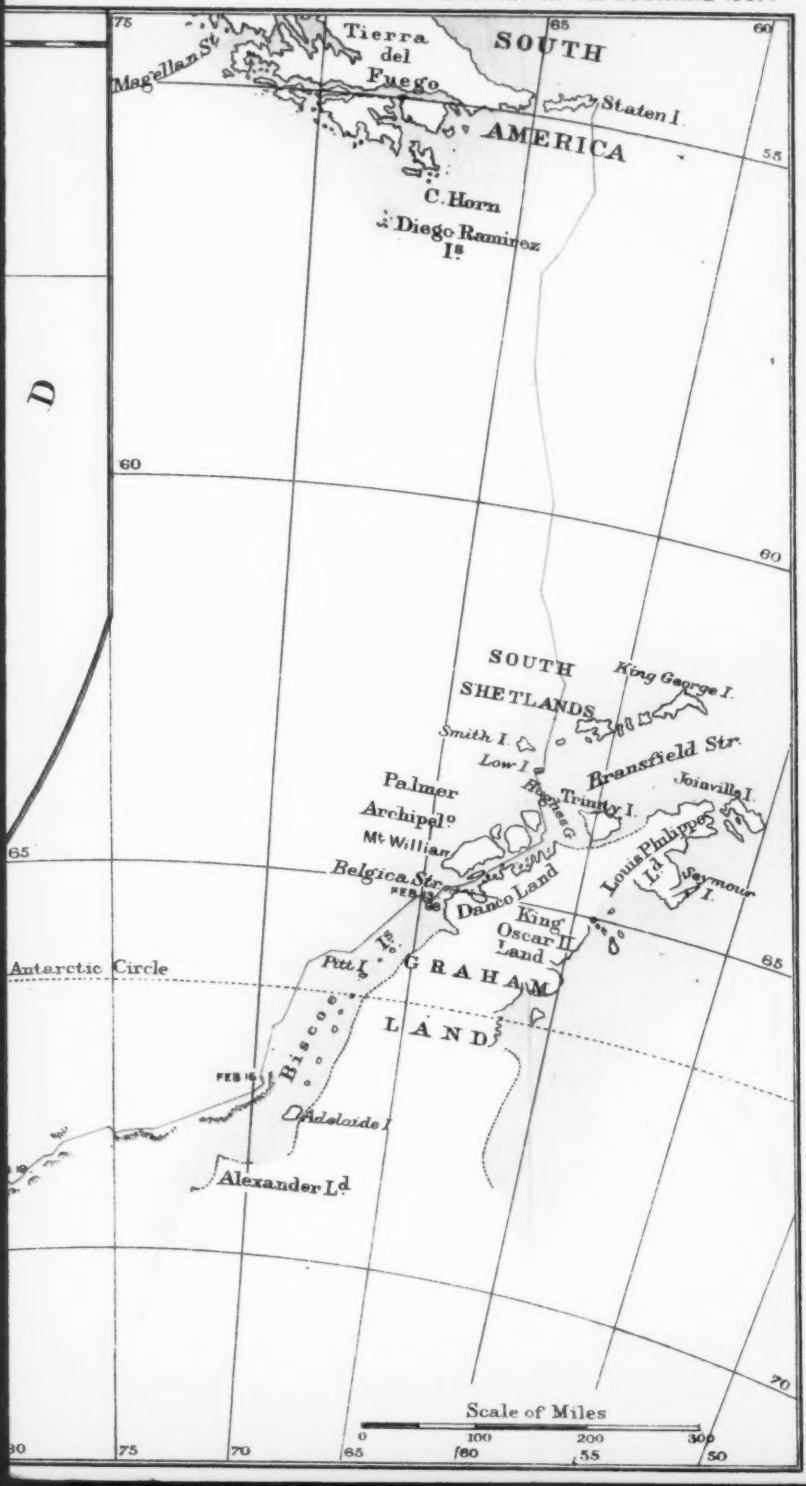
These photographs were taken in the imperfectly known region of Portuguese East Africa between the Zambezi and the Pungwe, and are of considerable interest. They are half-plate platinotypes, and many of them are extremely well taken. The following is a list of the titles:—

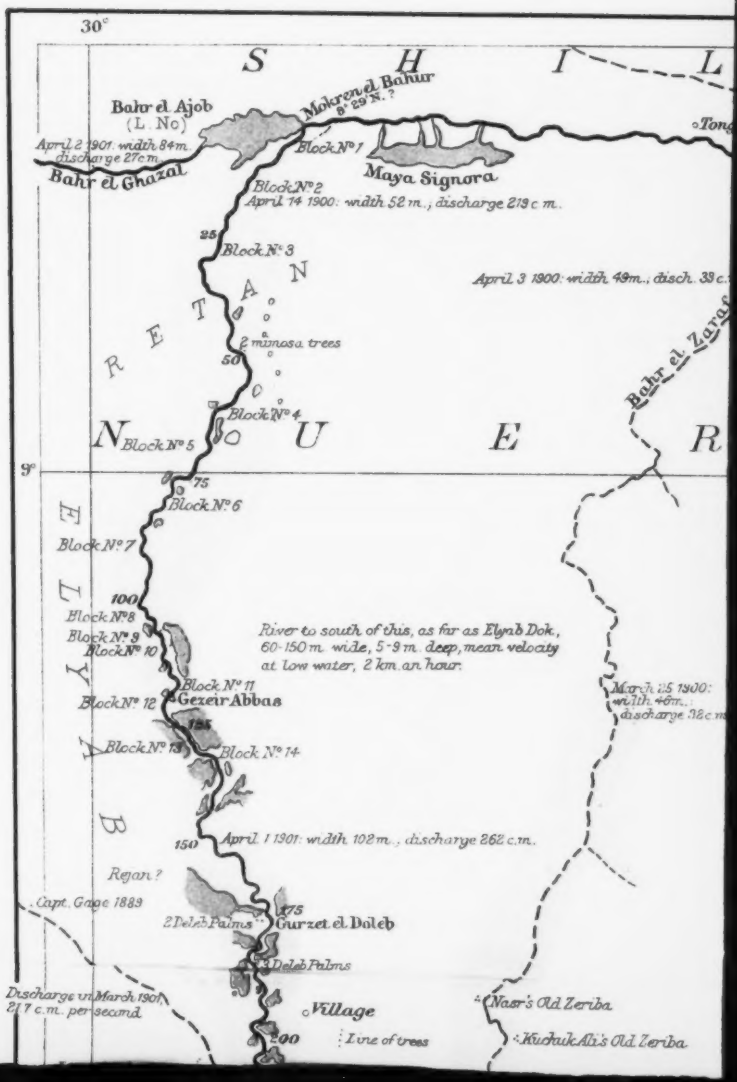
(1) Barue hut showing stockade defence at Mungari; (2 and 3) Breakfast by the roadside; (4) Bed of torrent at foot of the hills near Katandiga's kraal; (5) Camp at Mungari; (6) Porters marching in the bed of the Muira river; (7 & 8) Members of Barue expedition in camp with hunting trophies; (9) Commandant and secretary of Tambura with "boy;" (10) Mdaba with Makombe inside kraal, Mungari; (11) Makombe and indunas; (12 and 13) N'yaswimbo and Dundumura indunas of Makombe with ivory for the King of Portugal; (14) Interpreter and servants of expedition; (15) Misongwe, kraal of N'Canga; (16) River Zambezi from Tambura; (17) Mount Zuma from Misongwe, 6 kilometres distant; (18) Porters resting; (19) View across valley of Gairedsi river, Myanga plateau in distance; (20 and 21) Fort D. Amelia, Tambura; (22) Mungari—kraal of Makombe; (23) "Kopjeland" between Konfer's and Mungari; (24) Bed of N'yamakombe river; (25) Kopje north of Konfer's; (26) On the plateau above Katandiga's; (27) River Zambezi, looking towards Zupata gorge; (28) Katandiga's kraal, with Boandwa mountains (700 metres); (29) Split rock kopje between Konfer's and Katandiga's; (30) On the plateau above Katandiga's.

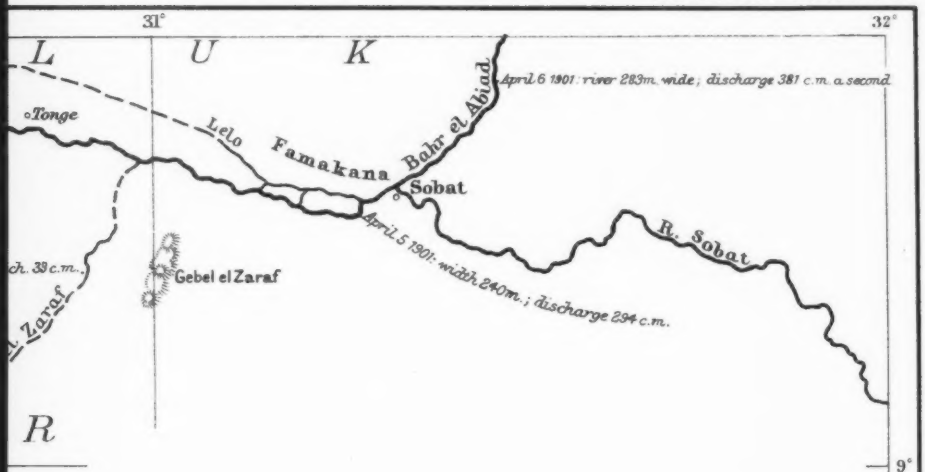
N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

DA
64
30
65
C. Dannebro
C. Rasmu
C.T


SKETCH OF
DANCO LAND THE BELGICA STRAIT
AND
PALMER ARCHIPELAGO
Surveyed by
CAPT G. LECOINTE.
1898.
Scale of Miles
0 10 20 30
1 inch = 12 miles (approx.)
Track of the Belgica
64
63
62
61
Mt Pierre
Mt Allo
C. Neyt
Christiania Is
LIEGE
1
Brugmann Mts
Auguste I.
Two Hummocks
I
C. Harry
I.
C. van Sterneck
HUGHES INLET
Briabmont Bay
C. Kaiser
C. Spring
C. Murray
BRABANT
Gand
I.
I.
Solvay Mts
Buls B
C. d'Urseł
C. Houzeau de Lehaye
C. Lagrange
Schollaert Chan.
STRAIT
C. Reclus
Charlotte Bay
Delaite I
Nansen I.
C. van Ryswyck
C. Anna
Wilhelmina Bay
Wyck I.
Brooklyn I.
Pelseneer I.
La Plata
ANTWERP
ISLAND
Osterrieth Mounts
C. Hyppolyte
Rongé Is
C. Charles
Errera Channel
C. Felicie
C. Edwin Astrea
C. van Beneden
Borgen Bay
Mt William
Lemaire I.
Andrews B.
Glaciers
Neumayer Channel
Biscoe Bay
WIENCKE
Bryde I.
C. Lancaster
Wauwerman's Is
C. Errera
C. Willems
C. Renard
Guyou Is
Wandel
Horgaard
Vedel
Lund
Lemaire Channel
C. Rahir
Monneaux Is
Flanders Bay
Dannebrog Is
Rasmussen
C. Tuxen
BELGICA
DANCO
COAST
Peter Is I.
FEB 27
JAN 4
DEC 13
SEP 19
FEB 24
FEB 19
OCT 19
NOV 25
OCT 7
MAY 4
JAN 31
21
AUG 10
JUN 22
FEB 19
JUL 9
APL 2
MAR 1
APL 25
21
JUN
MAY 15
MAR 20
MAR 14 90
MAR 2
70
100
95
90
85
80
65


Tierra del Fuego
Magellan St.
SOUTH AMERICA
Staten I.
C. Horn
Diego Ramirez Is.
SOUTH SHETLANDS
King George I.
Smith I.
Low I.
Bransfield Str.
Joinville I.
Palmer Archipelo
Trinity I.
Hughes B.
Mt William
Louis Philippe Ld
Seymour I.
Belgica Str.
Danco Land
King Oscar II Land
Antarctic Circle
Pitt I.
GRAHAM LAND
Biscoe
Adelaide I.
Alexander Ld
Scale of Miles
0 100 200 300
60 55 50
75 70 65 60 55 50


30°
S H I L
Bahr el Ajob
(L. No)
April 2 1901: width 84 m.
discharge 27 c.m.
Bahr el Ghazal
Makren el Bahur
9° 29 N.?
Block N° 1
Maya Signora
Block N° 2
April 14 1900: width 52 m.; discharge 219 c.m.
25
Block N° 3
April 3 1900: width 49 m., disch. 33 c.
2 mimosa trees
50
Block N° 4
Block N° 5
Bahr el Zaraf
9°
75
Block N° 6
Block N° 7
100
Block N° 8
Block N° 9
Block N° 10
River to south of this, as far as Elyab Dok,
60-150 m. wide, 5-9 m. deep, mean velocity
at low water, 2 km. an hour.
Block N° 11
Gezeir Abbas
Block N° 12
March 15 1900:
width 46 m.
discharge 112 c.m.
125
Block N° 13
Block N° 14
150
April 1 1901: width 102 m., discharge 262 c.m.
Regan?
Capt. Gaige 1883
2 Deleb Palms
175
Gurzet el Doleb
Deleb Palms
Discharge in March 1901
21.7 c.m. per second
Village
200
Line of trees
Nasr's Old Zeriba
Kuchuk Ali's Old Zeriba



MAP OF THE

BAHR EL GEBEL

from a 'Report as to Irrigation Projects'

by

SIR WILLIAM GARSTIN, K.C.M.G.

1901.

Scale 1 : 1,000,000.

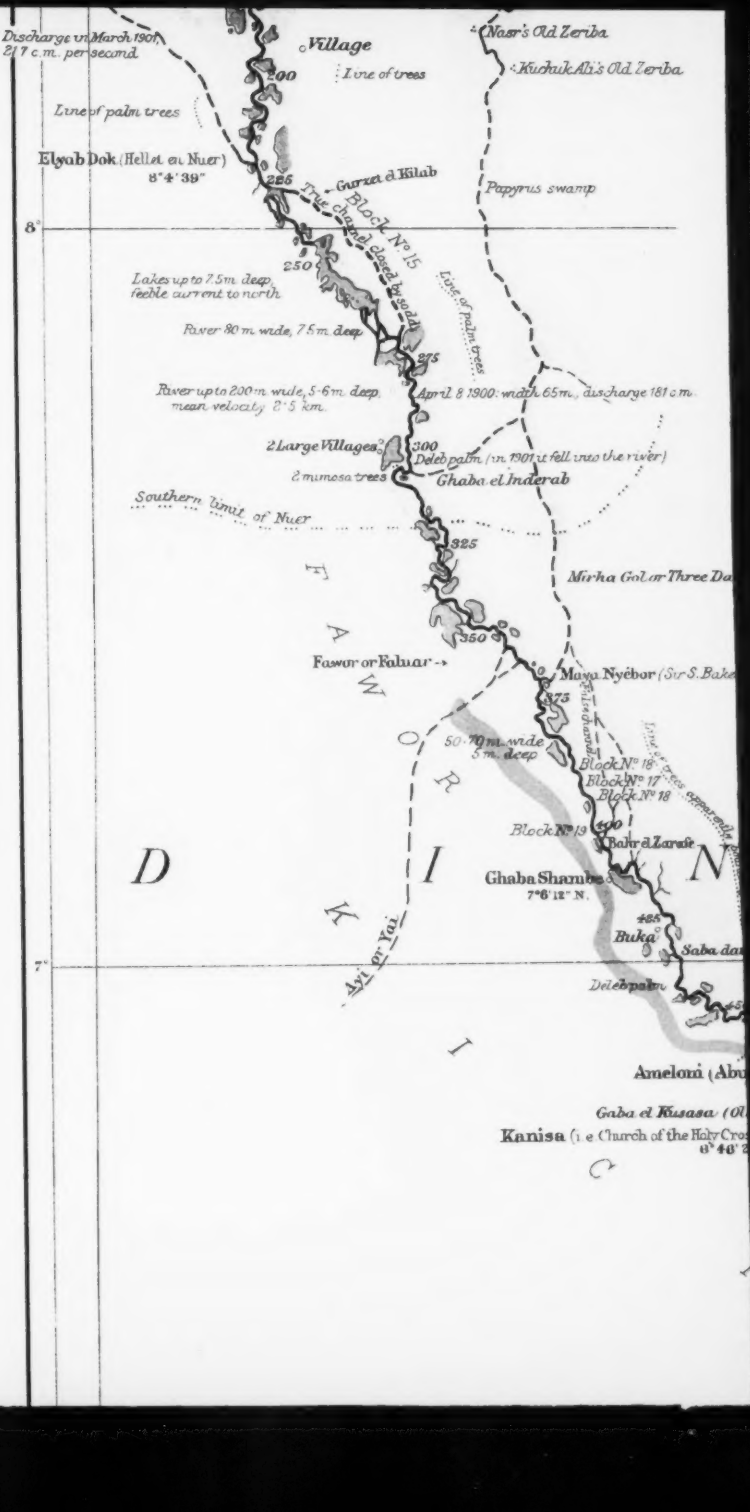
0 10 20 30 40 50 60 70 80 *Kilometers*

0 10 20 30 40 50 *Statute Miles*

Statements of the Width, Depth, Velocity (per hour) and Discharge (per second) are made in meters and cubic meters.

The Figures along the River denote the Distance above Lake No in Kilometers.

The Blocks of Sadd, numbered 1 to 19, have all been removed (1899 to 1900) with the exception of No. 15.


Discharge in March 1901
217 c.m. per second
Village
200
Line of trees
Nasr's Old Zeriba
Kushuk Ali's Old Zeriba
Line of palm trees
Elyab Dok (Hellet el Nuer)
8° 4' 39"
225
Gurza el Kilab
True channel closed by sudd
Block N° 15
Papyrus swamp
8°
250
Lakes up to 7.5 m. deep
feeble current to north
Line of palm trees
River 80 m. wide, 7.5 m. deep
275
April 8 1900: width 65 m., discharge 181 c.m.
River up to 200 m. wide, 5-6 m. deep
mean velocity 2·5 km.
2 Large Villages
300
Deleb palm (in 1901 it fell into the river)
2 mimosa trees
Ghaba el Inderab
Southern limit of Nuer
325
Mirha Gol or Three Da
F A W O R
350
Fawor or Fahuar →
Maya Nyébor (Sir S. Bake
373
50-70 m. wide
5 m. deep
Block N° 18
Block N° 17
Block N° 18
Block N° 19
400
Bahr el Zaraf
D I N K A
Ghaba Shambe
7° 6' 12" N.
485
Buka
Saba da
7°
Ayi or Yai
Delebpalm
Ameloni (Abu
Gaba el Kusasa (O
Kanisa (i.e. Church of the Holy Cro
9° 40' 2
C

The Figures along the River denote the Distance above Lake No in Kilometers.

The Blocks of Sadd, numbered 1 to 19, have all been removed (1899 to 1900) with the exception of No. 15.

Lagoons. *Swamps.* *'Highland.'* *Forest.*

The 'Highland' commences as a rule 0·25 m. above the summer water-level, and gradually rises until the Forest is reached. Much of it is submerged in Flood.

The Bahr el Gebel, from Lake No to Gondokoro, has been reduced from the Compass Survey Maps on a Scale of 1:370,000, which accompany Sir W. Garstin's Report. These have been checked by a few Latitudes obtained by observation and inserted upon the Map.

In laying down the Meridians we accepted Major C. W. Watson's determination of the Longitude of Rejaf (Geog. Journ., Nov., 1899). This places the Mouth of the Sobat in Long. 31° 20' E.

According to Major H. H. Austin (Geog. Journ., May, 1901) the Sobat mouth lies in Long. 31° 32' E., or 12 m. further East. This difference may be due to an error in the Long. assigned to either of the terminal stations, to an under-estimate of the distance between the Sobat and Lake No, or to a small error (not exceeding 2°) in the general trend given to the Bahr el Gebel.

E. G. R.

8°

7°

Three Dabbes 7°32 N.

r S. Baker, March 19 1871)

T U K A

N

I C H

H

Saba daurat (7 Bends)

Southern limit of papyrus swamp

450

Line of trees & palms apparently bounding the marshes

Trees

525

Akorber

Trees

550

Dinka Village

L. Powendael

Many spills into marshes

575

Fantenl am

Holy Cross

9° 46' 2a'

6°

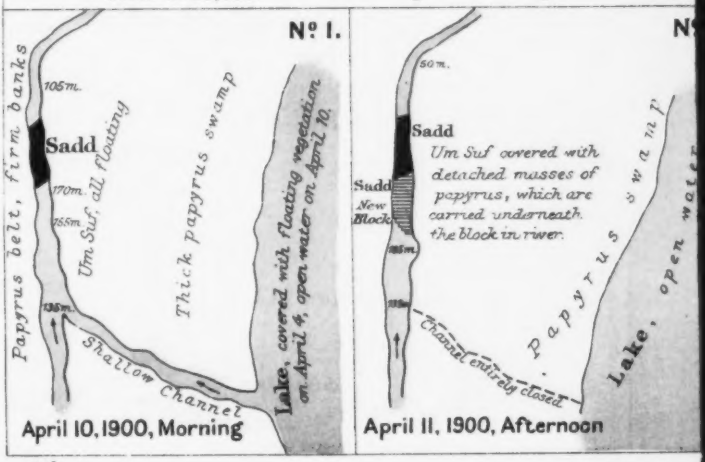
Northern limit of the country leased

SKETCHES ILLUSTRATING THE FORMATION OF A SADD B

Scale 1:50,000.

Kilometers.

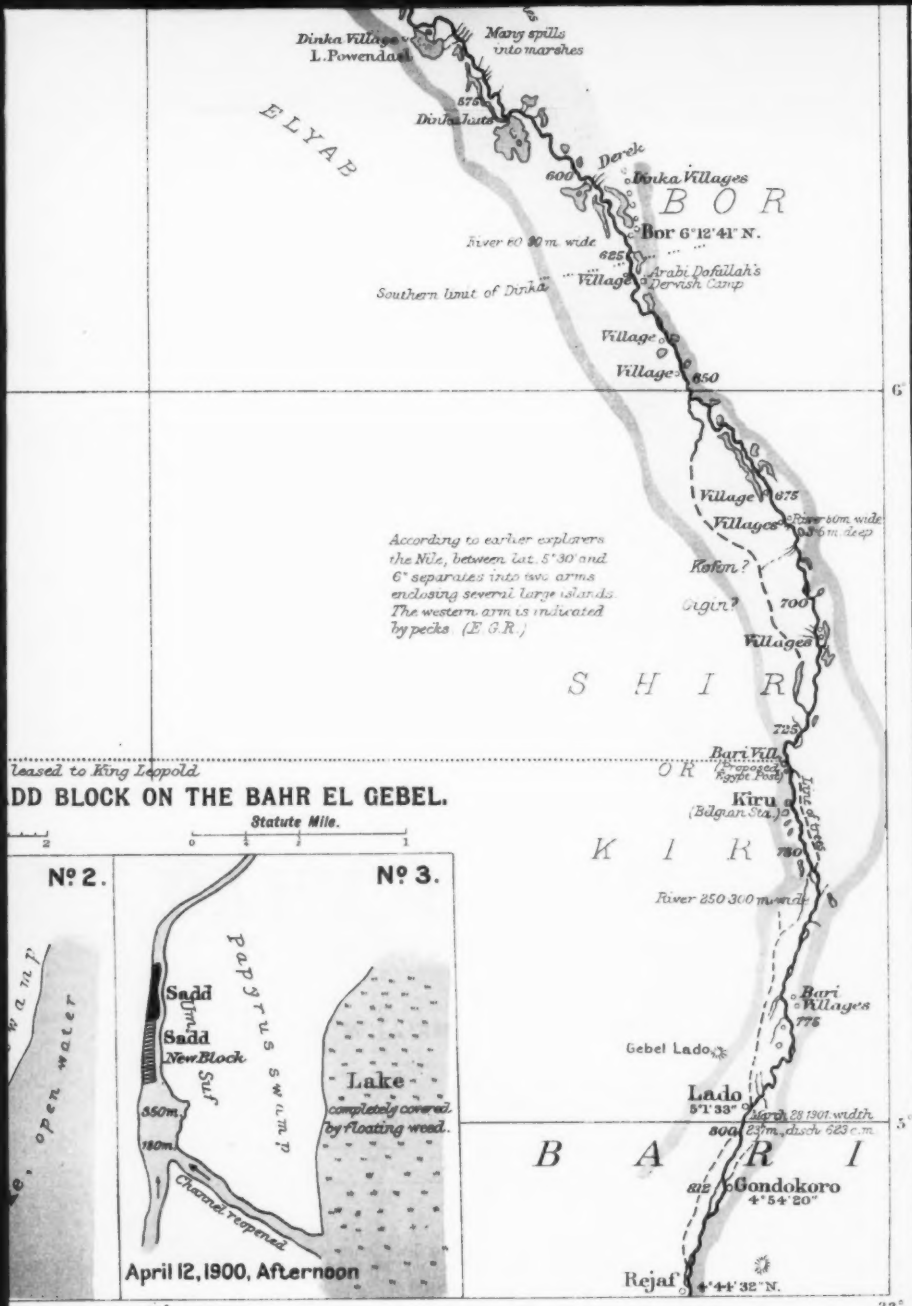
0 1 2



30°

E. G. Ravenstein

Published by the



d by the Royal Geographical Society.